# The Pageant of Nature

*British Wild Life & Its Wonders*

EDITED BY

P. Chalmers Mitchell

D. Sc., LL.D., F.R.S., C.B.E.

# THE PAGEANT OF NATURE

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Edited by
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*Photo: Stanley Crook*

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*From a Colour Transparency by Reginald A. Malby, F.R.P.S.*

# THE PAGEANT OF NATURE

## British Wild Life and Its Wonders

## INTRODUCTION

By P. CHALMERS MITCHELL, D.Sc., LL.D., F.R.S., C.B.E.

> Life is sweet, brother. There's night and day, brother, both sweet things; sun, moon, and stars, brother, all sweet things: there's likewise a wind on the heath. Life is very sweet, brother.
>
> GEORGE BORROW.

MODERN civilization is herding mankind in cities. It would be futile to rail against an economic process that seems inevitable, and unwise to forget advantages that it brings. Town life gives us better wages or salaries, and many conveniences in the way of society, education, medical attendance, light and heat, amusements, wider opportunity and a closer contact with our fellows. But however a cage be gilded or snugly furnished, it remains a cage. Men in cities are caged creatures, every hour of their lives entangled in artificial conditions. Their senses and emotions from time to time flutter against the bars. The soft breath of spring, birds singing in a park sanctuary, a coloured poster on a hoarding, awaken old memories or even inborn longings. We crave the wind on the heath, the leaves and flowers of the fields, some sight or hearing of the living things of the wide world. We are tired of our sophisticated environment, of the electric light, the smooth pavement, the office, the workshop, the club and the cinema. We long for what Walt Whitman called the "primal sanities of Nature."

Nature is within the reach of nearly all of us in this country. In these fortunate islands, set between the Continent and the Atlantic Ocean, we escape the harsh extremes of climate to which our position on the globe would otherwise submit us. The heat of summer and the cold of winter are tempered by soft winds from the sea. Even in a summer of great heat and drought like that of 1921, or in a winter of historical severity, there are always sheltered nooks to be found where plants are growing, and some kind of animal life is active. A few of our smaller and more delicate mammals may remain dormant in winter, but most of them are active all the year round, and, indeed, even more easily seen in the cold weather, when they come nearer to human habitations. The red deer deserts his remote fastnesses to steal hay from the farmyard or turnips in the fields; the fox and the badger quest round the outskirts of the villages; otters, when the rivers are frozen, will hunt for windfalls in the orchards or even rob the vegetable garden; hares and rabbits scrape through the snow or come into the gardens, and a multitude of small fry squeak and gibber by night, or take advantage of any glimpse of the wintry sun.

There is no time round the year when bird life is not abundant. We have many permanent residents, from owls to robins, and

there is none of them not bolder or easier to see in the months when smug citizens think the country bleak and dull. Almost before our summer visitors have begun to leave us, the winter migrants are seeking our shores. Probably there is no country in the world where month by month, all the year round, the lovers of birds have spread for them a more plentiful and more varied feast.

Let it be admitted that insects and creeping things are less abundant in winter. The more exciting to find them and to ponder over their ways of life! I have seen spiders hunting on Dartmoor early in January when a blink of sun had melted the snow from a patch of heather. There are late moths and early moths, and it is not only for idle exercise that bats will come out and hawk on a bright day in any of the winter months. Then, if you dredge up some of the leaves from the bottom of a ditch, even in mid-winter, there are always living creatures to reward your searching. And there is the seashore with its abundant life.

> O the gleesome saunter over fields and hillsides!
> The leaves and flowers of the commonest weeds, the moist still freshness of the woods,
> The exquisite smell of the earth at daybreak, and all through the forenoon.
>
> WALT WHITMAN.

> The world is so full of a number of things,
> I'm sure we should all be as happy as kings.
>
> R. L. STEVENSON.

Talking of animals, I have insisted most on the sights of winter, because spring, summer and autumn require no commendation. For at least nine months of the British year the pulses of wild life are quickened. The grass rustles with life, the water and the woods, the plains and the hills, and the air above us can hardly furnish space for the creatures which inhabit them. Courting, fighting, seeking food, rearing, guarding and teaching their young, all the busiest and most engaging parts of the drama of life are in full swing. Vegetation, too, with us is almost perennial, and there is no season in which some miracle of growth of bud, shoot or flower may not be seen. The last leaves have scarcely fallen before the buds of the earliest trees have begun to swell. Even when the woods are bare they are almost more interesting than in the leafy months. Let us say nothing of the lovely tracery of the naked branches against the skies of winter. Let us remember that every kind of tree has its typical mode of branching, its characteristic form and massing, best studied when it is not obscured by a heavy mantle of leaves.

The Pageant of Nature is open to us all the year round, without any interval or ringing down of the curtain. And it can be enjoyed from many points of view. I have been with passengers in an aeroplane and airship who complained of the monotony of the landscape unrolled below them. To me it was entrancing to try to identify the trees in a wood, the crops in a field, from their forms and colours seen from this new aspect. There are people who must read or talk all the time in an express train although from the windows there is a perpetual interest for the seeing eye. But even a better "seat" in the free theatre of Nature is the saddle of a "push" bicycle. Pedalling silently along English roads or lanes, in the early morning hours, or "when the downy twilight droops her wing," I have come suddenly across more different kinds of our British birds and beasts than at any other time.

None the less, those who are willing to walk see most of the fair. The theatre of Nature is democratic and the cheapest seats have the best view. Stout but silent boots, old clothes, field-glasses and a hand lens, a loving curiosity and a great patience are the chief equipment required. The late W. H. Hudson, in my opinion the most revealing English naturalist who has ever lived, made his entrancing observations with no other equipment. He would go out from his cottage at dawn with all the day and the evening before him,

*Photo: C. W. Colthrup.*

THE EDGE OF THE WOOD.

and, as he once told me, never was dull for a minute at any season in any weather, when he was alone with Nature. The songs of birds, flowers blowing or setting their seeds, the ways of squirrels and rabbits, earthworms stopping their burrows, busy ants or burrowing wasps —there was pleasure and profit to mind and body in all of them.

### Knowledge the Key to Enjoyment

" The Pageant of Nature " is a book of the words for those who wish to enjoy the play of wild life which has no beginning and no end. I am not going to say that a programme is necessary, and that unless you have knowledge you will not enjoy Nature. But animals and plants are engaged on their own business, much indeed of which is furtive and very far from being thrust on our notice. The more we know the more we shall see, the more discover and the more enjoy. The enjoyment of Nature goes hand in hand with Nature study.

There are many ways of studying Nature. First and oldest, there are the lore and lure of the hunter and sportsman. I am not going to decry pursuits merely because I have no mind for them. Hunters and sportsmen were the first naturalists and have laid broad and deep foundations of our knowledge. But their modes and their objects are falling out of fashion—to my mind fortunately, because I cannot see any rational distinction between the excitement of boys chasing a cat in a garden suburb and sportsmen at an otter hunt. In our pages you will not hear the hunter's horn, or get advice on the breeding of pheasants.

Then there are the collectors. Science owes a greater debt to them. Charles Darwin, collecting beetles in the Cambridgeshire fens, learnt the methods by which on his voyage in the *Beagle* he laid the first foundation of " The Origin of Species." Animals and plants must be collected before they can be studied, classified and named, and many of those who have added most to our knowledge of the fauna and flora of the remoter parts of the earth have begun as boys collecting in the English woods and fields. But there is now little excuse for the collector in this country, and many reasons why he should stay his hand. The ambition of the naturalist in this country should be, not to show a friend a collection of the skins of birds or the local beetles in a cabinet, but to be able to take him to some place where the rare plant or the common plant, the rare animal or the common animal, is to be seen alive. The naturalist should be a chief agent of preservation, especially of the rarer plants and animals, not, as is too often the case, one of the most determined because the best-informed agents of destruction. And so in " The Pageant of Nature " you will find no lists of rare species, no directions for skinning or mounting or drying.

### Every Student a Discoverer

All the authors who have contributed to our pages are first and foremost students of the living thing in its natural surroundings. Their skill with the camera or with the pen has been used to illustrate, describe and explain the living creature, to tell what they have seen and know, and to help others in the first place to see, know, and rejoice in the same things. The pages are designed to be read at home, to serve as guides in the open, and to be re-read on return. And it is to be remembered that living things have one great advantage over the physical world in their endless variation. A chemical experiment, an observation in electricity or magnetism can be set down exactly and repeated indefinitely. The writer in London describes what is to be done and seen. The reader in Birmingham or Banff, in Connemara or Cumberland, puts the same chemicals in the test tube, adjusts the wires and the resistances, and gets precisely the same result. But no one plant is exactly like another plant ; no one animal is a faithful copy of its fellow. Individuals and species differ in their habits, modes of growth, adaptations, in exquisite harmony with their environment. A guide to living Nature is at best a general direction. Every student of Nature can be a discoverer. Our object has been to turn all our readers into watchful lovers of Nature who will soon know far more than we have been able to tell them.

# The Awakening of Spring

By TICKNER EDWARDES

COMING out into the village garden at close of the tempestuous day, it is hard to believe that the rough north-east wind has gone at last. Day after day, for a long week back, an avalanche of icy air has been driving relentlessly over the world, blotting out all colour from earth and sky alike. For this is the direful token of all easterly winds. Whatever the season, they come wearing the ragged grey garb of winter, and if the time be only March, though the month be well on to its close, it is real winter that the blustering north-east wind brings back in its train. All the bright promise of spring incontinently vanishes. The woods and hedgerows seem never so dark and bare, nor the shrouded sky so bleak, as on these whistling, chill, unkindly days.

But it is always in this wise with the English spring. Every March there comes this seemingly interminable spell of cold, rough, dismal weather, with never a gleam of sunshine, and winter dearth and desolation suddenly back on all the land. Then, one memorable evening, a change comes. The wind falls like a shot bird. The black sky parts in the west, letting through a flood of rosy light. The air softens to pure balm, and the birds begin to sing with a strange force and sweetness. Soon the last vestige of grim cloud has disappeared, and one may stand hushed and wondering beneath a vault of pure amethyst, watching the evening star go down in a glory of crimson and gold.

This is the real awakening of spring. It is true that ever since the " Turn of the Days "—the moment in mid-winter when the sun first began to take a wider arc in the sky—all Nature has been alert and busily doing. But much of this early preparation has been secret and little evident. It needed this cold, dark period, when the north-east wind drew its mantle of concealing grey over the land, to reveal the true pace of things by hiding progress for a while ; and now comes a morning, following the overnight break in the chill turbulent weather, when one scarce knows which way to turn for the loveliness of all things. With the first dim light of dawn such a gladness of song uprose from wood and field that to lie longer abed was impossible even for the hardiest. Presently the sun broke over the hill-top and swept the world with a flood of amber light. The western zephyr began to bend the highest branches of the lane-side elms, and little, joyous, hurrying freshets of air stirred among the yellow crocuses and daffodils in the garden. Looking out through

*Photo: F. T. Newman.*

The Blackbird is one of the first songsters to welcome the spring.

the ivied lattice, the bees could be seen pouring from their hives into the sunny air, filling the morning with their rich, deep labour-song. On the roof-tree above, starlings crowded, chattering gaily; and across the lawn below, white with a veneer of glistening dew, thrushes and blackbirds were running to and fro, leaving behind

*Photo: J. J. Ward.*

One cannot look for long in a primrose glade at this time without seeing a Brimstone Butterfly settling among them with closed wings, when it is lost at once in the general sulphur hue.

them innumerable herring-bone tracks of green over the frosted silver. Within an hour we have left the village behind and are off into the wilds, caring little whither our steps lead, when all the world is running high under this new glad promise of life.

It is indeed a world of wonders now, after the long spell of hueless cold. Against the blue of the sky the great elms rear their turrets and battlements of purple blossom, every twig loaded with rich colour. By the green roadside verges, gold-eyed celandine shines out at every step. In the hedgerows the elders are putting out fresh young leaves, and the honeysuckles are drawing trails of emerald through the maze of budding branchlets. The blackthorn is almost in full flower; looking up the lane as we go, it stands out in broad silver washes incredibly bright under the morning sun. A week or two ago the blackthorn was the darkest thing by the way. Then the matted thorny growth put forth an infinity of tiny buds like beads of pink coral. Just before the rough east wind began to blow, every bud had taken to itself a green crown. Now the whole bush is covered with minute white flowers, each enshrining a spark of amber; look where one will in the chequer-board of fields, the hedges are draped with these housels of shining white.

Over the foot-path through the fallows, where the clefts between the rough clods are sown thick with blue veronica and rose-red dead-nettle, to the hazel-woods that, from afar, seem already to wear their full weight of vernal leaves. But these are not leaves that, in March, make the hazel-copses so impenetrably green. There are fat leaf-buds in plenty, but no sign yet of opening leaf. All the luxuriance of fresh young growth is made up of the catkins—the male flowers of the hazel—hanging in thick clusters from every branch and twig; thousands upon thousands of pendulous gold-green tassels all slanting one way in the gentle breeze. As we pass into the wood, the brilliance of the morning fails, and a dim

*Photo: J. T. Newman.*

The cheery music of the Song Thrush is the dominant note of early spring.

indoor light gathers about the path, so closely are the catkins matted together overhead. Without keen eyes, one may lose the chief beauty of these hazel-woods in March under

the shadowy twilight. Nature in springtime has her elusive, secret phases, as well as her bold flaunting moods. The female flowers of the hazel—the little tufts of feathery crimson set amid the lowermost branches—are hard to see at first, though when once found they glow on all sides like mimic danger-lamps in the gloom.

It is not in these older, denser hazel-copses that the primroses and wood-anemones abound thus early in the season, for all they make a pale sulphur streak on either side of the winding way. To find primroses and anemones now in all their thronging beauty, one must push on to the clearings—the wide, bare open spaces, sheltered yet free to the whole day's sun, and set deep in the heart of the wood.

The thing that chiefly strikes the eye on chancing suddenly upon one of these clearings, after tramping a mile perhaps through the sober green twilight of the woods, is the way in which the whiteness of the anemones swamps the rich yellow of the primroses within a dozen yards, at most, of the point of view. Standing on the brink of the sun-flooded plane, and looking away over the sea of blossom, it is the primroses that give the dominant note of colour near at hand. But a little way onward, their pure yellow begins to fade away, and the distant prospect is just one level of shining white, broken only by a spot of violet shadow here and there, where an oak or beech tree stands islanding the sunny waste. The anemones, though fewer in number, lift their heads higher than the primroses, so that if the glance rove far afield nothing is seen but their gleaming white stars.

*Photo: C. W. Cotthrup.*

The whole bush of Blackthorn is covered with minute white flowers, each enshrining a spark of amber.

In all these massed effects of blossom the impulse of the onlooker is to be content with a wide general view. Yet half the beauty and the wonder of these flower-strewn clearings is lost if their detail of growth and circumstance be disregarded. One can lie down for hours amongst primroses and anemones at this time of year, and yet never exhaust their loveliness and mystery.

*Photo: T. M. Blackman.*

Starlings, chattering gaily, gather to pick up a meal amidst the dew-laden grass.

Here, in the outset, is a thing that has puzzled many. The whole wide clearing is musical with the hum of countless bees; but watch as carefully as one may, a honey-bee is never seen on a primrose. To the human eye the primroses seem just as alluring as the wind-flowers. But the bees pass them severely by, and it is the white anemones that are eternally nodding under the weight of their caress.

In old days the primrose used to be the classic type of simpleness among wild flowers. Yet one cannot lie among them for long without the truth dawning that the common woodland primrose is a very complex flower indeed. A handful plucked at random, and closely examined, will reveal a host of curious things. First it is found that a primrose is not a primrose—in the sense that it is one kind of flower

*Photo: Reginald A. Malby.*

The Spring Crocus adorns many a by-path in the more cultivated glades.

*Photo: C. W. Colthrup.*

## A PRIMROSE GLADE.

To find Primroses now in all their thronging beauty, one must push on to the clearings—the wide, bare open spaces, sheltered, yet free to the whole day's sun, and set deep in the heart of the wood.

alone. The blossoms in the hand divide themselves pretty equally into two varieties —the one with its centre closed by a little feathery whorl of buff-hued anthers, the other with the median tube quite open, except that there is poised just within the mouth of it a tiny globe of translucent green. Obviously, one thinks, these are male and female flowers. Yet, if each blossom be torn apart, it will be found that both have the two sexual traits fully developed and complete. The feather-eyed flower has the green stamen concealed in the tube below ; the other has also its ring of male anthers, yet borne as a hidden and inaccessible treasure deep in the trumpet beneath. And while we meditate on this strange dual inversion of parts in the primrose—wondering whether the flower is self-fertilizing, seeing that its sweets are stored far too deep to be reached by the tongue of any ordinary insect—a new sound perhaps is heard on the gently moving air. Something, that looks at first glance like a little fluffy brown moth, is hovering over one of the primroses near at hand. Its crystal-clear wings and general gait soon reveal it as some sort of fly, and its enormous trunk-like proboscis is thrust deep down into the trumpet-bell of the flower. On an instant it is off and away to the next kindred blossom, and a moment later to the next, avoiding the white anemones in its aerial path as scrupulously as the honey-bees shunned the primroses. This queer furry-brown atom is almost the only thing that will be seen on the primroses now or at any time. It is easy to understand why the short-tongued hive-bee ignores their sweets ; but why the butterflies, whose tongues can fathom much deeper calyces, should give them so wide a berth, is something of a mystery. Yet there is one butterfly of early spring which, by its peculiar fondness for the primrose, goes far to redeem the strange neglect of its kind. One cannot look about for long in a primrose glade at this time without seeing a brimstone

*Photo : Henry Irving.*

By the green roadside verges, gold-eyed Celandine shines out at every step. Its first leaves, which are heart-shaped, only precede the flowers by a few days.

*Photo: Reginald A. Malby.*

Everywhere wild Daffodils spring out of the ground, blowing their yellow trumpets, and nodding in the breeze.

*Photo: Howard Bentham.*

The Wood-anemones, though fewer in number, lift their heads higher than the Primroses.

*Photo: Henry Irving.*

Water Crowfoot obscures the dark waters of many a pond by its mass of flower set in a tangle of luscious green.

butterfly, like a flying primrose of larger size, passing from flower to flower, or settling among them with closed wings, when it is lost at once in the general sulphur hue.

*Photo: Henry Irving.*

Marsh-marigolds throng the river's bank, tracing the windings of the distant streams.

To the river, last of all, on this never-to-be-forgotten day of spring's real awakening—the old, reed-fringed river, where the willows crowd down to the water's edge, dipping their tresses in the gentle flow. They are all golden too, now, these river-side willows, from their lowest drooping branches to the topmost twigs that make an arabesque of gold against the azure of the vernal sky. It is fulfilment, where, before the rough north-east wind drove all colour from earth and heaven, there was but a stealthy promise of gold here and there in the maze of swelling buds.

Standing on the ancient foot-bridge, whose crazy timbers have spanned the water so insecurely yet for so long, one looks down the shining winding way, and scarce knows whether to be moved the more by wonder than by thankfulness at all the squandered loveliness of the scene. The waters dream by under the feet, every now and then an eddy filling up with a note like a silver bell. The happy birds load the sunshine with music. A kingfisher lances by, drawing a streak of glittering blue from bank to bank. That is a moorhen calling to his mate, deep hidden in the jungle of whispering reeds. Marsh-marigolds throng the river's bank ; they are golden too, yet theirs is but a miserly sprinkling compared with the royal largesse of the willows. Though there are a thousand other things to draw the glance on this first veritable dawning of spring, none but the willows convey a sense of entire fulfilment. Looking up the glowing vista, it is as though one looked forth through flung-back golden gates at the " city all built of pure shining gold " lying beyond, resplendent and eternal.

*Photo : S. Crook.*

As he darts along the stream the Kingfisher draws a streak of glittering blue from bank to bank.

*Photo: Henry Willford.*

The Nightingale, one of the most famous British migrants, is better known to the ear than to the eye in early summer.

# 1.—THE MIGRATION OF BRITISH BIRDS

By A. LANDSBOROUGH THOMSON, O.B.E., D.Sc.

THE most familiar aspect of bird-migration in the British Isles is the appearance in spring and early summer, year after year, of a number of well-known species. The first swallows fly twittering over the pond, the first warblers sing sweetly in the gardens, the first corncrakes call harshly in the fields, the first swifts dash screaming round the house-tops. Then for a few brief months these birds are with us, busy with the duties of the nesting season, until autumn comes, when they and their young take their departure for "warmer lands and coasts that keep the sun."

There is, however, another side to this picture. Just as the birds which are summer visitors to this country must obviously be winter visitors to some more southern lands, so there are birds which spend the summer farther north and come to this country for the winter. The fieldfare and the redwing, cousins of the thrush, are examples of winter visitors to the British Isles. In addition, there are birds, such as some of the sandpiper group, which spend the summer farther north and the winter farther south, and are known to us only as birds of passage in autumn and in spring.

In contrast to these three kinds of migrants there are the numerous species which are apparently resident in that they are to be found here throughout the year.

But it does not follow because a species is resident in this sense that the individual birds are necessarily sedentary. The individuals may all be migratory, winter visitors and summer visitors of the same species replacing each other with the seasons. Or some individuals may be sedentary, or at most local migrants within the limits of the country, while others are migratory in high degree. Such a common species as the song-thrush, found all the year round in the British Isles, is composed of both sedentary and migratory individuals, while of the latter some are summer visitors, some winter visitors from the north, and others merely birds of passage. This is indeed characteristic of the British Isles and attributable to the temperate climatic conditions that prevail therein. The country lies within the region where the summer distribution and the winter distribution of many species overlap.

*Photo: Capt. H. Morrey Salmon, M.C.*

The Redshank is one of those migrants which are represented all the year round in the British Isles. In summer it haunts fens, marshes and boggy districts.

As we have spoken of migrants being of different kinds, it is necessary to note that the distinction is a relative one based on our own local point of view. Migration, broadly speaking, is actually all of the same kind. Birds which are summer visitors here are winter visitors somewhere else, and the terms have no meaning except as applied to the particular country of which we are thinking. We may go even further and restrict the application of the terms in some cases to particular parts of the country; the snow bunting, for instance, is a winter visitor to most parts of this country, but is found in summer not only in more northern lands but also on the tops of the higher Scottish mountains.

Migration from a cosmopolitan point of view, then, is all of one kind. Individual birds are either migratory or sedentary, and species are composed either wholly of migrants, wholly of residents, or of a mixture of both. When migration takes place it is from summer quarters in a colder country to winter quarters in a warmer one, and the principle is that every bird breeds in the coldest part of its range. It is indeed more accurate to speak of colder and warmer climates than of northern and southern countries, for migration is by no means necessarily from north to south. Much migration indeed takes place in Europe on an almost due east to west line, the British Isles and neighbouring countries enjoying a much milder winter than is experienced in the same latitudes farther east. The general trend of the most important migratory movements in North-eastern Europe is south-westerly in autumn and north-easterly in spring. The accompanying map indicates diagrammatically the main movements affecting the British area.

It is of interest in passing to mention that many of our summer visitors are not

content to find winter quarters in the northern sub-tropics, but traverse the equator to the southern temperate regions, where they perform the paradox of "wintering" in the summer of the other hemisphere in which the seasons are the reverse of our own. It so happens, however, that no migrants native to the southern hemisphere travel far enough to visit us during our summer in like manner.

*Photo: A. M. C. Nicholl.*

The Cuckoo is perhaps the most interesting of our spring visitants by reason of its parasitic habits. This young Cuckoo is resting before the great southward flight of autumn

We have spoken of spring and autumn as the seasons of migration, but it must not be supposed that it is only during a brief period twice a year that migratory movements take place. There is indeed not a single month of the twelve in which migration of some kind does not occur in the British area. The arrival of summer visitors may begin as early as February, and for some species it is in full swing before the end of March. April is a great month of influx, but May is still more important, while even in June arrivals are still occurring. Many of the later birds, however, are *en route* for more northern lands where the summer is tardier in beginning. The exodus of our winter visitors may also begin before the end of February, although as a rule rather later than the first arrivals from the south, and similarly continues until May or even June.

The autumn emigration begins on a small scale in July, and the arrival of birds from the north to a rather less extent, while in August the southward movements both to and from the British Isles become pronounced. The first birds to leave us are probably adults which have been unfortunate in their nesting operations—the adult cuckoos are also regularly early in their departure—but they are soon followed by larger numbers of young birds, only a few weeks old, travelling in advance of their parents, while the latter are in many cases either rearing second broods or undergoing their autumn moult. In September and October the autumn movements are at their height, and in November they still continue. In December and January a few kinds of birds which customarily travel in winter are regularly recorded, and the onset of very severe weather—even as late as February, when the spring migration is at hand—may often lead to a revival and extension of the ordinary autumn movements.

Thus we see that the stream of migrants is a tide which is always ebbing and flowing. Only for a few weeks twice a year, about the beginning of July and the beginning of February, is there a period of "slack water" before the turn.

Relatively few species of birds in this part of the world are wholly sedentary; most of

*Photo: Capt. Oliver G. Pike.*

**WHINCHAT ALIGHTING.**

The Whinchat is one of the migrants arriving in spring and taking its departure in the early autumn.

them are at least partly composed of migratory individuals whether or not some representatives are present at all times of the year; and throughout the greater part of the four seasons, as we have just noted, movements of one kind or another are taking place. Nevertheless we see little enough of migration actually in progress, and the ordinary inhabitant of the country-side might never suspect its existence were it not for the complete absence of some species at certain seasons, or the periodical variations in the numbers of others.

*Photo: Henry Wilford.*

A "partial migrant," the Meadow Pipit nests most commonly in pasture and moorland districts, and is frequently the victim of the Cuckoo.

Migration takes place very largely at night, even in the case of birds which are not ordinarily nocturnal, and for this reason usually escapes notice. Sometimes, however, the cries of the travelling flocks may be heard overhead on a still night, even from city streets; and to the lighthouses and lightships round our coasts vast numbers of migrants are often attracted, under certain atmospheric conditions, by the blinding glare of the lanterns, when many dash themselves to death against the glass.

The careful observer on the coast may sometimes see evidence of migration during the day, especially in autumn when flocks come in over the North Sea or follow the shore-line southwards. And from sea-going vessels birds may sometimes be seen journeying far from land and even seeking temporary rest on the rigging or decks. Migration is less often observable in inland districts, but, especially in the secondary winter movements that sometimes occur after the onset of very severe weather, flocks and small parties may sometimes be seen travelling across country.

It was at one time supposed by many that birds commonly migrated at great altitudes and so escaped observation during the day, but further evidence, including the experience of aviators, has destroyed this belief. It seems, indeed, that it is unusual for birds, whether migrating or otherwise, to seek those levels of the upper air in which they would be invisible from the ground. Much migration, in fact, takes place at very low altitudes, often within a few feet of the ground or of the surface of the sea. A similarly exploded belief is that migrants fly at high speeds, greatly exceeding those of their every-day flight; a leisurely, steady pace is actually the rule. Of the distances which are covered in a single flight it is

difficult to speak with certainty, but in some parts of the world there are wide expanses of open sea which must be traversed by land birds without a halt.

The broad fact of bird-migration has been known to mankind for thousands of years, as witnessed by references in *The Book of Job*, in the *Iliad* of Homer, and in the poems of Anacreon, but it is only within comparatively recent years that the subject has become a matter for exact scientific study. What was formerly merely a marvel to be wondered at, or a fact to be taken for granted, has aroused the curiosity of the nature-lover and the interest of the biologist. The study of migration, however, has been hampered by the great difficulties in the way of adequate observation, and we are in consequence still far from being fully informed as to the facts of the case. One method of study lies in the compiling of records of arrivals and departures in different parts of the country, and much has been done by this method in the case of those species which are wholly summer visitors or wholly winter visitors to the British Isles. More useful still has been the systematic collection of records of migration observed actually in progress at the light-stations round our coasts, and it is from this source that a great part of our present knowledge is derived. Intensive study by experienced ornithologists at particularly favourable stations has added still further to the growing store of facts.

The study of movements in the mass is nevertheless incapable of yielding the whole secret of the matter. It must be supplemented by some means of tracing the journeys of individual birds so that we may discover, for instance, where birds from a particular summer locality go to in winter as compared with those from other summer localities, and whether or not it is the native individuals of a species which take part in a particular movement. Of late years a good beginning has been made both in this country and abroad with the study of migration by the method of bird-marking. Young birds are

*Photo: T. M. Fowler.*

The Great Skua, seen in the act of alighting at the nest, breeds in the Shetland Isles and is a rather uncommon winter visitor to the remainder of the British coasts.

marked in the nest (or old birds may sometimes be caught for the purpose) with an aluminium ring placed round one leg. This ring is inscribed with the name and address of the marking organisation (e.g. "Witherby, High Holborn, London," or "Aberdeen University") and with an identification number. Some of these marked birds, usually a very small proportion, are subsequently reported in various ways and from various places, sometimes several years later. In this way exact information is being accumulated as to the journeys performed by individual birds, and many interesting facts have already come to light.

*Photo: Capt. H. Morrey Salmon, M.C.*

The Lapwing, although partly sedentary in the British Isles, is also both a summer visitor and a winter visitor.

It has been shown by the marking method, for example, that most of our native starlings are either strictly resident or migratory in a merely local sense; a few may be summer visitors to the British Isles, but only a single record from just across the Channel at present supports this view. On the other hand, starlings visit the British Isles in winter from Denmark, Southern and Arctic Norway, Sweden, Finland, Northern Germany, the Baltic States and Western Russia. Records of starlings marked abroad also show journeys from Finland to Southern France, from Central Germany to Spain and Portugal, and from Hungary to Italy and Northern Africa.

Similarly, in the case of the lapwing or peewit an autumn emigration of native birds has been very clearly demonstrated, although a few have been shown to be sedentary. Of the migrants many go no farther than from Northern Britain to Ireland, but others reach Western France, Northern Spain, and Portugal.

Striking results have also been obtained in the case of British swallows, but these will be mentioned in a subsequent chapter in which it is proposed to treat that species as a typical example of a migrant.

Certain general features of the phenomena of bird-migration stand clearly forth. Most striking of all is their vastness, the hundreds of species and millions of individual birds which participate, the thousands of miles that are covered twice a year in some cases, and the fact that there are only a few weeks in the year during which some movement does not occur. Then there is their complexity, as witnessed by such facts as that a single species may be represented in the British area by individual birds which are respectively residents, summer visitors, winter visitors and birds of passage, or that the directions of simultaneous movements may cross each other as in the case of southward migration along our eastern seaboard in autumn and the east to west flight of immigrants from Holland to the south-east of England at the same season. And despite the vastness and complexity of the phenomena there is their wonderful regularity, the exactness with which movements are repeated at the same time year after year, and the accuracy with which some birds, as shown by marking, return to the same breeding places in successive seasons.

Bearing these facts in mind it is not surprising that the meaning of it all is still wrapped in mystery. It is perhaps not difficult to suggest the purpose which is served (that some end must be served by a habit so expensive in energy and

*Photo T. M. Blackman.*

**COMMON TERN ALIGHTING.**

One of our summer visitors, this bird makes a mere hollow on the ground, amongst shingle, sand, coarse grass and vegetation, or on rocks or dried wrack around the British coasts.

life is obvious). Migration towards the north in spring procures a greater choice of nesting sites, wider and less crowded feeding grounds, and longer hours of daylight during the breeding season. Southward movement in autumn serves to avoid the cold, the hunger and the shortened day of the northern winter. But there is a difference between a purpose served and an actual cause. It cannot be supposed that the birds act reasonably to achieve a conscious purpose; and it cannot be that the seasonal conditions themselves create migration, for much migration occurs, as we have seen, long before the need is pressing or even apparent, and the phenomena are at the same time too complex and too regular to be the effect, annually repeated, of mere immediate causes. Everything indeed points to migration being a deeply ingrained habit, part of the inborn nature of the bird. As such it must have had its origin in the history of the race (differing perhaps for different kinds of birds), in the conditions under which the various species spread to occupy their present geographical areas, or in the great climatic changes that have occurred since birds first appeared upon the earth. Granted some such origin, it is less impossible to explain the action of immediate causes in reproducing the sequence of events in each successive year; the changes of the season, or possibly the changes in the bird itself between the physiological states of the breeding and non-breeding seasons, may serve to pull a trigger which releases the pent-up mechanism of the instinctive habit.

These questions of purpose served, ultimate origin, and immediate stimuli, by no means exhaust the wonder and the difficulty of the subject. There remains the great question as to how the instinct works, as to how, for instance, migrants find their way so successfully, often over wide stretches of sea and in the darkness of the night, and often, in the case of young birds travelling before their parents, over an unknown course. But when we ask this question we are inquiring into the nature of instinctive behaviour, into one of the inner secrets of life. Is it not well worth asking?

*Photo: F. T. Newman.*

The flocking of Starlings in the autumn may be the prelude to a southward movement for the winter.

# 2.—THE GOLDEN EAGLE'S "THIRD EYELID"

By SETON GORDON, F.Z.S.

With photographs by the Author

THERE is an old saying that the eagle can look straight at the sun, yet suffer no discomfort; and on the wildest days amongst the high hills, when the gale whistles through the corries, when on the arms of the storm snow is whirled in blinding flakes, the eagle is abroad. Seeming to revel in his battle with the elements he shoots in the teeth of the blizzard when the mere mortal, fighting his way step by step, must needs keep his eyes averted from the blinding snow.

I have more than once envied the golden eagle his power of facing sun and storm undismayed, and have marvelled at his capacity for so doing.

Then one day, when photographing a full-grown eaglet in its eyrie, I made an interesting discovery. Every now and again the eaglet drew across its eye a curious semi-opaque film and, more by good luck than anything else, I was fortunate enough to obtain a photograph showing this film, or third eyelid as it is called, covering the

The Third Eyelid of a half-grown Golden Eaglet is clearly seen in the photograph which was taken at close range.

THE NORMAL APPEARANCE OF THE GOLDEN EAGLE'S EYE.

When not in use the Third Eyelid is folded back in the anterior angle of the Eagle's eye. The bill of this bird is half covered with the fur of a mountain hare. Taken from life in an eyrie.

**A FULL-GROWN HEN EAGLET'S EYE WITH THE THIRD EYELID DRAWN OVER.**

The Third Eyelid is the semi-opaque film which gives to the Eagle the power of facing sun and storm undismayed.

eye. The two large photographs which are here reproduced were taken at very close range, with the camera resting on the edge of the eyrie. One of the prints shows the eagle as it appeared normally; the other with the third eyelid over its eye. The third eyelid, or to give it its scientific name, the nictitating membrane, when not in use is folded back in the anterior angle of the eagle's eye. It is a whitish semi-transparent membrane, and may at times be used to clean the eye. Certainly the eagle uses it more frequently when alarmed.

But may it not be that the third eyelid, being semi-transparent, is used by the king of birds in very severe weather to protect the eye and yet allow him vision when facing a blinding storm of rain and snow; or again when looking straight into the eye of the sun on a June noontide?

In the Central Highlands the Golden Eagle chooses a tree for a nesting-place more often than a rock. This eyrie is in a birch, 1,600 ft. above sea-level.

Even when very young the eagle uses its nictitating membrane, for it may be seen clearly in the photograph of the half-fledged eaglet, whose breast is still covered with the first down. Perhaps the most interesting point about these photographs is that in them the eagle appears as a blind bird.

The nest in which this eaglet was reared was placed near the top of a very old Scots pine, in a deer forest of Aberdeenshire. Now it is a curious fact that in the Central Highlands the golden eagle chooses a tree for a nesting-place more often than a rock. The tree is usually a pine, but not always so, as I have seen an eyrie built on a birch tree not more than fifteen feet high. In this situation the great eagle's eyrie was a most conspicuous object until the birch was in leaf, yet, so far as I know, the nest was never disturbed.

All the time I was photographing the young eagle in the pine tree, the parent bird was perched upon a large stone on a hill-top at the opposite side of the glen. Had she any anxiety from my presence at the eyrie she effectually concealed it, for she never once approached near enough to see whether any harm befell her family.

As will be seen from the photographs the eaglet had recently been feasting upon a mountain hare, for its bill is still half covered with the animal's fur.

Eagles seem to prefer hares to grouse or ptarmigan—probably because they are more easily captured. Rabbits are not generally present in an eagle's haunts, but where they are, they are frequently preyed upon.

*Photo: M. Best.*

Terns, upon being disturbed, rise into the air above their nesting ground and with deafeningly angry cries fly round and round the intruder like the flakes of a heavy snow-shower being played upon by a fickle wind.

# 3.—OUR SEA-BIRD BREEDING-HAUNTS

By RICHARD KEARTON, F.Z.S., etc.

NO wild creatures in the British Islands are more interesting or more easily studied with field-glass and camera than our sea-fowl.

In spring-time the adult birds, on love and breeding bent, gather from all the scattered seas at certain well-known points used for nidification purposes by their forbears for untold ages.

The Farne Islands, off the coast off Northumberland, are at once the most accessible and interesting sea-bird breeding-haunts round the English coast.

On the innermost of the group, upon which the lighthouse and the ruins of St. Cuthbert's Tower stand, a few pairs of eider ducks breed every season, and under protection many of them have grown so tame and confiding that they will allow the ornithological visitor to stroke them as they sit covering their eggs. Once across the "Kettle"—a tide-wracked sheet of water separating the Inner Farne from the Knoxes and Inner Wide Opens, two islands connected at low water by a ridge of boulders and shingle—and we are in sea-swallow land *par excellence*. Here Arctic, common and Sandwich terns breed in such vast numbers that upon being disturbed they rise into the air and with deafeningly angry cries of protest fly round and round the intruder like the flakes of a heavy snow-shower being played upon by a fickle wind. Their eggs lie scattered on the ground so thickly that the visitor is obliged to examine every foot of sand and shingle lest he should tread upon a clutch and crush it. Some idea may be gathered of the vast winged population congregated here when it is stated that upon one occasion the watchers counted no fewer

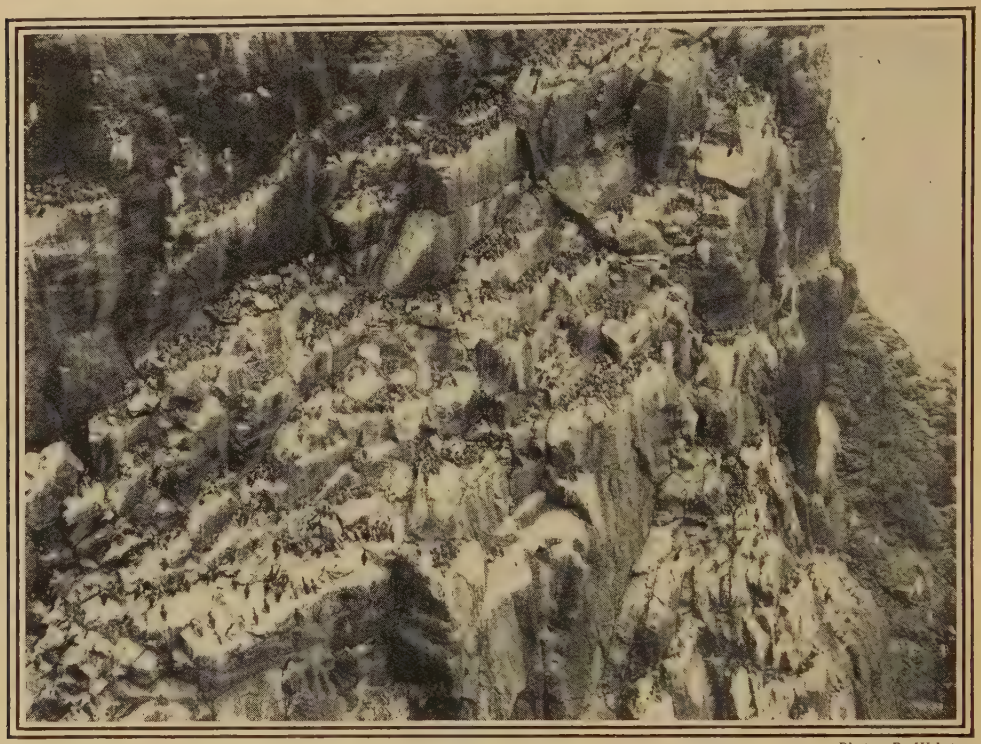


*Photo: P. Webster.*

Upon many an island fastness in far northern British waters, Common Guillemots make their home in thousands. Ledges of rock on Rathlin Island, where the photograph was taken, and the St. Kilda and Shetland groups are favourite breeding-haunts of this bird.

than fifty clutches of Sandwich terns' eggs lying upon forty-five square feet of ground.

When the young ones are hatched they wander about, until families become so hopelessly intermixed that it is difficult to understand how the parent birds know their own offspring upon returning home with food. Indeed, it is to be feared they do not always succeed, if one may judge by the unseemly squabbles and fights frequently indulged in by the adult birds.

The Pinnacle Rocks, consisting of three vertical flat-topped stacks (shown end-on in our double-page illustration, and thus hiding the gaps between them) rising out of the sea only a few feet away from the island of which they once formed a part, are of world-wide fame. It has been computed that something like two thousand pairs of common guillemots breed upon these comparatively small rockstacks every season, and the prodigious din that they make morning, noon and night must be heard to be believed.

It will be noticed that a few pairs of kittiwake gulls nest on the very limited accommodation afforded by the few ledges and corners on the sides of the Pinnacle Rocks.

On the Broonsman Island great numbers of puffins and lesser black-backed gulls breed, and here and there a pair of herring gulls. The puffins have honeycombed the peat-covered portion of the island to such an extent in making their nesting burrows that the incautious visitor frequently falls through the thin crust of earth into one of their numerous tunnels.

The Megstone Rock, upon which a Spanish galleon came to grief in the days of the Armada, standing out of the sea a short distance away, is a favourite breeding-haunt of a large colony of cormorants. It is advisable to visit the Megstone early in the breeding season, because if the naturalist should be endowed with highly sensitive olfactory nerves it will prove a somewhat

unpleasant spot when the young ones are out and the rock is strewn with pieces of fish in all stages of decay and streaming with droppings. The smell is never too disagreeable, however, for the lesser black-backed gulls. Whenever they see a human being on the Megstone they know that the adult cormorants have left it, and hasten over to steal the scraps of fish lying about.

The Bass Rock, upon which the gannet, or solan goose, breeds, is the safest and most accessible rockstack known to the writer, who has visited it again and again, both before, and since, the lighthouse was built upon it. Here the gannets may be watched and photographed with perfect ease, whilst they sit on their nests, repair their old homes, or fight over some theft of materials. In this respect, like rooks, their morals leave something to be desired. These little differences account for splashes of blood on the rocks, or a bird blind of one eye that may occasionally be seen at a gannet breeding-station.

Before the lighthouse was built the solan geese made their nests just below the spot where the old cannon lies, and allowed visitors to walk about amongst them with no more protest than an occasional peck at the legs of the intruder.

Ailsa Craig, off the Ayrshire coast, is a far larger rock, and much more dangerous to wander about upon with a camera or field-glasses ; not, however, on account of its greater height—for it does not matter much whether one sustains a fall of a hundred feet or a thousand, as the end is very likely to be the same—but on account of the dangerous character of the ground. The slopes leading down to the ledges whereon the sea-fowl breed are of terrifying steepness, and in many places unsound.

A visit to what is called the Slunk, on the far side of the Craig from the lighthouse, will always repay the naturalist if he be sure-footed and steady in the head. Here he may stand on the edge of a narrow chasm some hundreds of feet deep and study kittiwakes, common guillemots and razor-bills on every ledge of the cliff in front and only a few yards away.

From a purely ornithological point of

*Photo : M. Best.*

Kittiwake Gulls on their nests are a common feature of island cliffs in northern waters. Ailsa Craig is an ideal rock for observation, if the naturalist be sure-footed and steady in the head.

view St. Kilda and its satellites, a group of small islands some forty-five to fifty miles north-west of the Outer Hebrides, are without rival in the British seas.

Some idea of the number of birds of different species congregating at this place to breed every spring may be gathered from Martin's account of what happened there during his visit. His party, consisting of seventy souls all told, consumed sixteen thousand eggs in three weeks, and the natives, who at that period numbered about three times as many as the visitors, ate more man for man. Martin saw twenty-nine baskets of eggs brought down from the cliffs in one morning, each of which held from four to eight hundred. Whilst reflecting upon these enormous figures it must not be overlooked that the majority of the birds, such as common guillemots, razor-bills, puffins, gannets and fulmar petrels, only produce one egg each.

If a gun should be fired at the foot of Conagher, a cliff rising something like twelve hundred and twenty feet out of the Atlantic, sea-fowl of many different species, from puffins near the top to green cormorants near the foot, pour forth in incomputable numbers. The sight is simply bewildering, and the sound of their wings is akin to the rumble of distant thunder.

The black guillemot, the storm petrel, the fork-tailed petrel and Manx shearwater all breed on the St. Kilda group of islands, which was until recently the exclusive breeding-haunt of the fulmar. This bird, strangely enough, is extending its area, and reoccupying ledges on cliffs where there is reason to believe it bred a few centuries ago in the Shetlands and other places.

Puffins breed on the island of Soa, close by St. Kilda, in such vast numbers as to beggar description. A visitor standing on the island one day threw a stone at a flock passing him and knocked down two, and

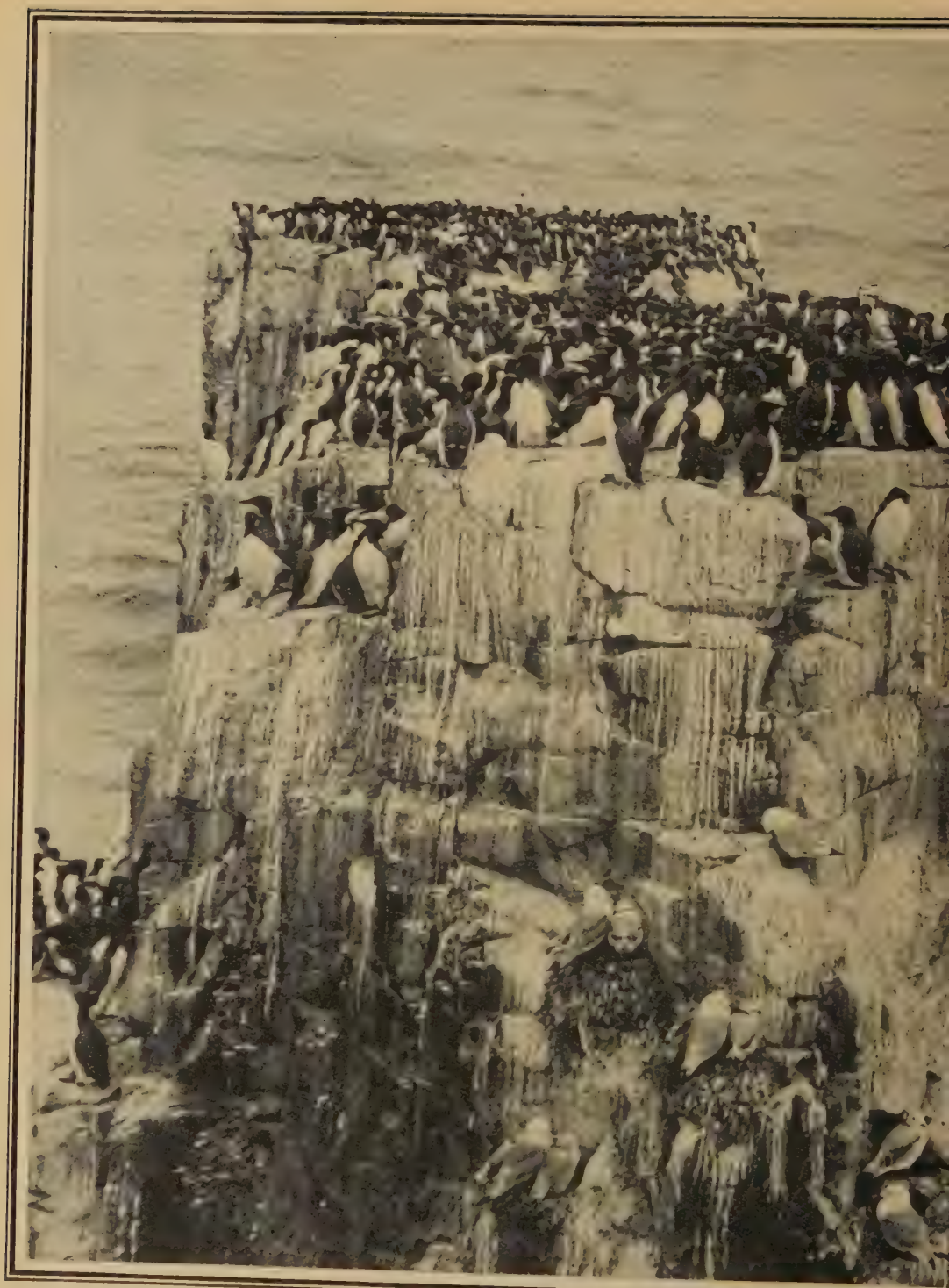
*Photo: S. Crook.*

The Black-headed Gull breeds on sandhills by the seashore or on the marshy brinks of meres and tarns, where it is equally at home. This illustration shows a rear view of a bird alighting on its nest.

*Photo: T. M. Fowler.*

**GANNET ROOKERY ON THE BASS ROCK.**

The Bass Rock is one of the most accessible breeding-haunts of the Gannet or Solan Goose.



COMMON GUILLEMOTS ON TH

It has been computed that something like two thousand pairs of Common Guillemots breed he
illustration, and thus hiding the gaps between them, also affo

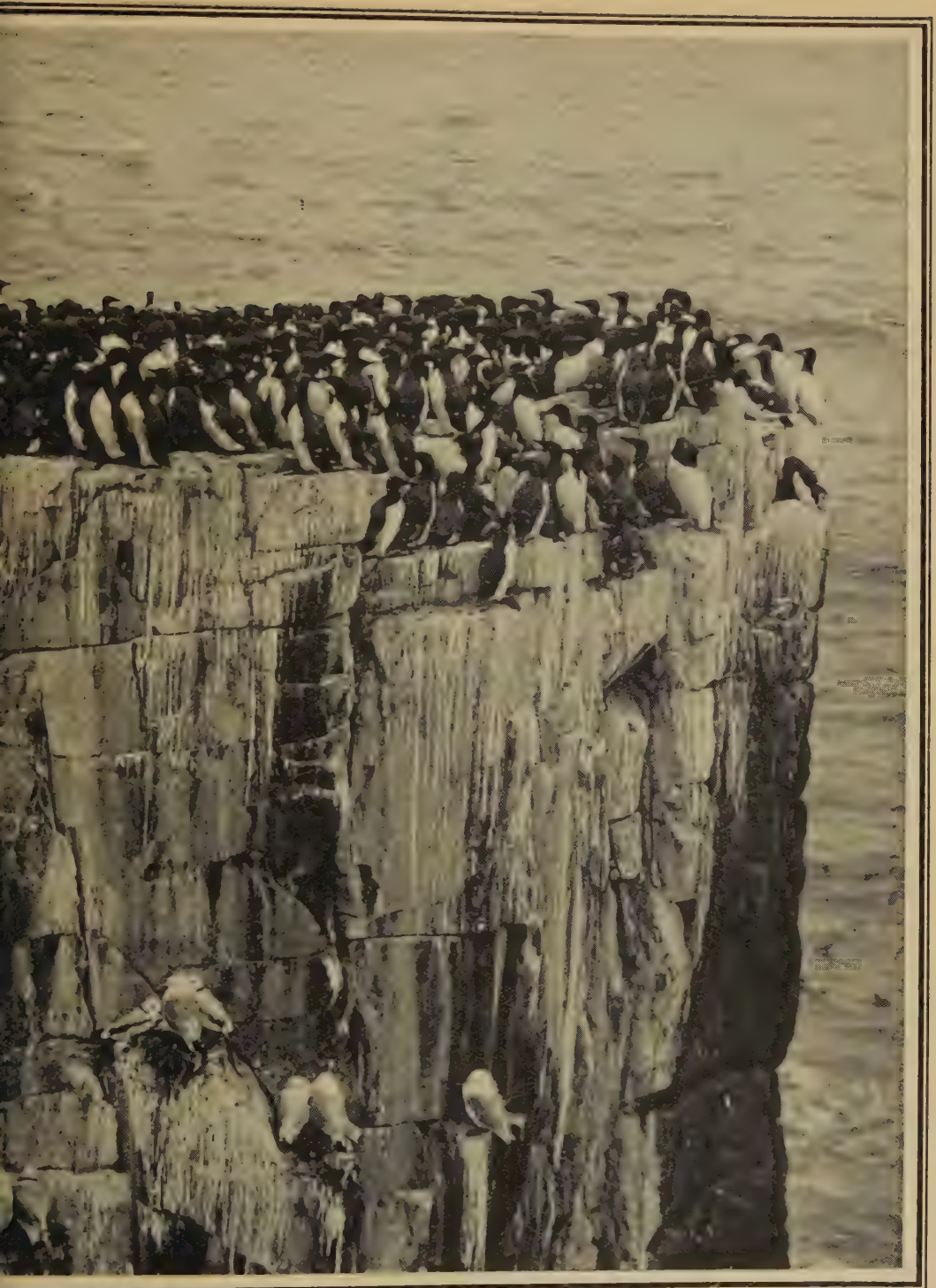


*Photo: P. Webster.*

**NNACLE ROCKS, FARNE ISLANDS.**

ry season. The rocks, consisting of three vertical flat-topped stacks, shown end-on in this pitality, on their ledges, to a few pairs of Kittiwake Gulls.

when the birds turned and flew over him they literally darkened the sky.

Solan geese breed in great numbers on Stack in Armin, and Stack Lee. One authority has computed the birds on these two stations and the islands near by to number two hundred thousand. During favourable periods of visibility they may be seen from the Outer Hebrides forty-five miles away, like ships with great white sails fully set.

Two or three decades ago the former bird was reduced to a few pairs in Unst and Foula, and would in all probability have completely disappeared from our list of British breeders had the bird not been afforded protection. The proprietors of Unst built a wooden hut on the top of Herma Ness and kept a watcher in it every spring. His efforts, (now under the direction of the Royal Society for the Protection of Birds) have resulted in raising the breeding stock from six pairs to a hundred or more, and the species may now be met with nesting on the Isle of Noss, not far from Lerwick. The Noup of Noss, on the eastern side of this island, is a famous sea-bird breeding-haunt with cliffs rising to a great height from the sea.

*Photo: M. Best.*

Common Guillemots resting on the ledges of the Noup of Noss in the Shetlands. Here they may be seen crowding every available ledge of the giant cliffs.

The great black-back, the lesser black-back, herring and common gulls may all be found breeding plentifully in the Outer Hebrides, to say nothing of black-throated and red-throated divers, greylag geese, eider duck, wild duck, teal, shelduck, ringed plover, oyster catcher, dunlin and other feathered friends met with on or by the sea.

The Orkney Islands, as might be expected, are rich in sea-bird life during the spring; but it is in the Shetlands where the naturalist will be charmed with the interesting home-life of the great skua, or bonxie, and also that of the Arctic, or Richardson's, skua in its greatest numbers.

Turning south, Ravenglass, on the Cumberland coast, is easy of access and affords striking pictures of sea-birds breeding on and near the sand-hills. Common terns are very numerous at this particular breeding-haunt, where a few pairs of Sandwich and lesser terns are also to be met with, to say nothing of oyster catchers and ringed plover.

*Photo: P. Webster.*

Puffins breed on many rocky islets in British waters. They nest in holes amongst loose boulders or in burrows, which they excavate in soft earth

*Photo: M. Best.*

Cormorants on their nests may be seen to advantage on the Megstone Rock near the Farne Islands if the naturalist visits the colony early in the breeding season.

The black-headed gull may be found breeding in colonies consisting of only two or three pairs on the boggy shores of some lonely mountain tarn, or in vast numbers on such shallow meres as Scoulton in Norfolk. Thousands of birds of this species nest every spring on the sand-hills at Ravenglass, but although within a few yards of the sea the old birds always fly inland in search of food for their young.

A peculiar thing noticeable at black-headed gulleries in June is that a young bird of this species may be able to fly quite well before it has been fed, but not afterwards, until the food has been disgorged or digested. Apparently conscious of this fact, a young gull falling into danger soon after a meal will disgorge the food and, taking wing, fly away.

The Saltee Islands, off the Wexford coast, are very rich in sea-bird life during the breeding season. Here great black-back, lesser black-back and herring gulls may be studied and photographed with ease, not to mention cormorants, shags, common guillemots, puffins and kittiwakes. Oyster catchers breed as commonly as the species can ever be expected to breed anywhere in what used to be ploughed fields before the tenant-farmer was evicted and the island became the undisputed home of rabbits, rats and sea-fowl.

Round the Welsh coast are to be found many headlands, islands, and rockstacks upon which sea-birds congregate and breed in varying numbers every spring. Among these may be mentioned the Great Orme, Puffin Island, Skerries, Bardsey, Ramsey, Skomer and Caldy.

The Scilly Islands, too, afford excellent opportunity to study the home-life of the sea-fowl; most of the species here referred to may be seen to perfection there.

The eastern coast of England does not lend itself to the breeding habits of such species as guillemots, razor-bills and puffins until the Yorkshire seaboard is reached, when at Speton and Bempton great colonies are to be met with on the ledges of the immense cliffs.

*Photo: Eleanor Shiffner.*

Upon naked rocks or situations among thrift, as shown in this photograph, the Lesser Black-backed Gull may be found nesting. The Outer Hebrides, the Saltee Islands, off the Wexford coast, and the Farnes, are excellent observation grounds.

# WHAT IS THE DIFFERENCE BETWEEN A TOAD AND A FROG?

In the full-grown Toad, the warty skin shows distinctly; it always squats lower on the ground than a frog; its head is also huddled down between its fore-legs.

*Written & Illustrated by M·H·CRAWFORD*

MANY people have hazy ideas about the differences that exist between a frog and a toad. To them the creature is a frog if it jumps, a toad if it walks. But then a toad can hop quite well if startled, and a frog often walks, so this distinction is worse than useless. There is, however, no possibility of mistake with regard to the eggs. Both lay their eggs in ponds and ditches, and the resulting tadpoles of both are very much alike; but the eggs themselves are strikingly different. Those of the frog are in masses; the black dot-like eggs are enclosed in thin, glutinous tacky envelopes that quickly absorb water and swell out to large globes of jelly. It is in this state that they are most familiar. As they absorb moisture they rise to the surface of the water and get entangled in weeds and roots round the margins of ponds.

It is often said that toads and frogs will not breed in the same pond, but the two different kinds of spawn have been found within a few yards of each other in the same pond at Harrow. It seems to be true, however, that interbreeding does not occur, though frogs and toads may live as close neighbours through the early spring months. When taken from the same pond, frog-spawn will always be found to be much more developed than toad-spawn. This is quite natural, as toads lay their eggs a little later in the spring than frogs.

A very peculiar stage is passed through by the immature frog, before it becomes a real tadpole, and after it

The Frog is quite clean-looking, with a smooth skin. The hind-legs are more than half as long as the body. Its notable feature is the hump on the back.

has left the gelatinous envelope of its egg-life. This is a kind of embryonic stage, in which the tiny creature has neither mouth, eyes, nor respiratory organs. Under

The Toad lays its eggs in chain-like formation in striking contrast to the egg-masses of the Frog. Both, however, lay their eggs in ponds and ditches.

its large, shapeless head, which seems to be divided underneath, it possesses two minute sucking pads by which it sometimes fastens itself to a bit of weed; usually, however, this intermediate stage is passed under or amongst the globes of jelly. Probably the sucking pads are useful in preventing the helpless atom from being separated from the mass of jelly before it is sufficiently developed to need food. At this time the digestive tube is rudimentary, and the body is nourished by the food it contained while still within the egg.

As soon as this food supply is used up—about two days from hatching—the embryonic larva becomes a real tadpole, with a soft mouth, nostrils, and intelligent, beady little eyes. Also its head is now quite separate from the plump round body. Hitherto it has been breathing by means of tufted gills branching out from the neck, but these external gills will soon disappear. Four slits are formed on each side of the neck, and these develop gradually into internal gills. Dissolved oxygen is now supplied to the blood by means of water taken in through the mouth, and ejected, after it has done its work, through an opening at the left gill-clefts. The mouth now possesses a sort of horny beak, capable of eating pond-weed, for at this stage the tadpole is partly vegetarian.

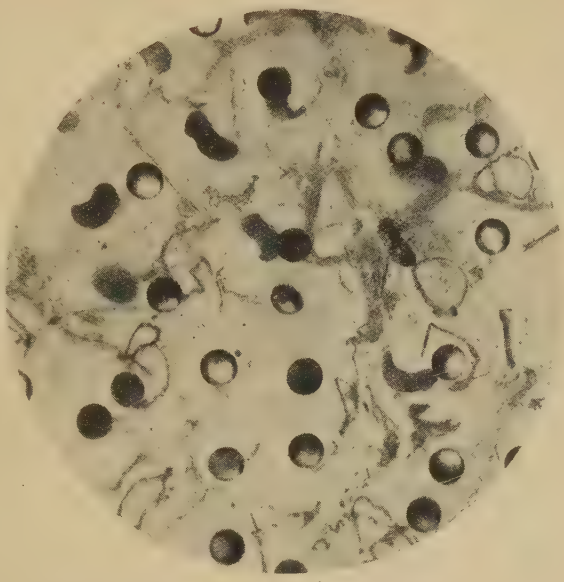
This brings us to the point when the tadpole is daily growing broader, when its bullet-like head seems to merge into the body. The colour of the body, too, is changing from a dark

The black dot-like eggs of the Frog are laid in masses, and enclosed in thin, glutinous tacky envelopes that quickly absorb water and swell out to large globes of jelly.

brown to a lighter tone, flecked and striped, in the case of the frog-tadpole, and the eyes are becoming lighter and more prominent. One can see the legs bulging under the skin, and soon the long hind ones

appear. Then the front legs also bud out, and, although the tail is still there, the tadpole stage is passed.

Just before the legs appear, however, an important physiological development occurs, due to a modification of the digestive apparatus: the tadpole becomes completely carnivorous, and, at times, cannibalistic.

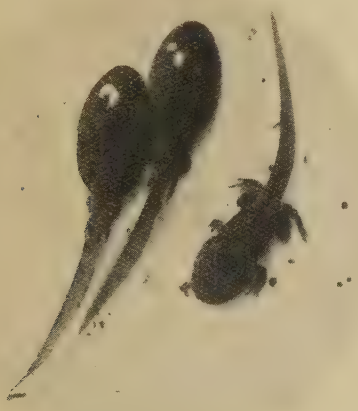


Frog-spawn in process of hatching out. When taken from the same pond as toad-spawn, the former will always be found to be much more developed, because Toads lay their eggs later in the spring than Frogs.

The tadpoles do not, however, seem to eat each other; they only devour those of their companions who have just acquired their whole complement of four legs. As soon as a tadpole is swimming about with four legs he is apparently fair prey for those who have only two. For a short time after the front legs appear the frog is comparatively smaller than he was before, and, perhaps, less strong; hence his vulnerability.

Before the young frog leaves the water a very interesting operation may sometimes be witnessed. Down amongst the weeds at the bottom of an aquarium or pond will be seen some tiny, semi-transparent shreds; these are the cast-off skins of the young frogs. This skin-casting or moulting is rather a serious business, no matter what living creature is concerned—bird, caterpillar or frog. Both before and after there is a period of quiescence and helplessness, and it is very likely that during this period the young frog is attacked by his companions.

Probably for much longer than one suspects, the young tadpole has been feeding on animal substances, plenty of which it



Two Frog-tadpoles with hind-legs, and a third with both hind- and fore-legs.

Toad-tadpoles as they appear at five days old. They are seen rising to the surface for the first time.

Before the young Frog leaves the water he casts his skin. In this photograph the Frog is seen beside the skin he has just discarded.

finds amongst the pond weed. But as soon as it loses its tail it begins to spend most of its time out of the water, and then its food becomes almost entirely insectivorous. As an adult frog it sometimes eats small slugs, or earthworms as they crawl along the ground; but its chief food consists of small insects. For this reason both frogs and toads are exceedingly useful. They eat plant-lice in the gardens and do good work in the autumn among the winged aphides.

In the winter the frogs hide in all sorts of damp, sheltered spots, such as holes in the ground, in the mud at the bottom of ditches, and in mossy crannies and hollows in tree stumps. Occasionally they seem to prefer drier places, and in the autumn have been found in trees. Young frogs have been seen climbing up tree trunks, clinging to the rough bark with their long hind-legs, just as a boy will swarm up a rope. Pollard willows are sometimes chosen, as these would obviously make ideal winter quarters if the weather became very mild and the frog did not sleep all the time. Indeed, numerous insects hide in the warm crevices of pollarded tree-tops. Still, hibernation in a frog is usually very fully carried out, therefore a mild winter would not be favourable to it. Damp, warm winters kill off hibernating bats, and for the same reasons would very likely kill off frogs too. As it is, many frogs die before spring, and it is only the hardiest that get through. During the winter torpor mouth and nostrils are closed, and the skin carries on the necessary respiration.

Though a toad is credited with possessing more intelligence than a frog, there are occasions when frogs are very quaint, especially when fairly young. If tamed sufficiently to take food, such as small fat worms, from the hand, they will sit up on their haunches, pushing each other away, and uttering little cries. These cries are most curious; small and high-pitched. I have heard a frog cry out in a similar way when accidentally hurt under a large stone. The spring croaking at the ponds is quite different from this rather squeaking cry.

A frog needs a much more watery situation than a toad. The latter is happy amongst stones, or in a greenhouse or aquarium, or in a crevice in an old wall.

A young Frog (with just a vestige of tail still showing) is quite different in appearance from the young Toad of about the same age as shown on the opposite page.

Ponds are therefore more frequently visited by frogs than by toads. A frog also seems happier and more at ease when in the water ; it will then always allow one to stroke its queer, " broken " back, as children call its hump. Of course, this prominence is not due to a broken back at all ; it is just the sharp angle formed by the juncture of the haunch bones and the spine. It is not nearly so noticeable in the toad. While the frog sits upright in the shallow water of the pond it puffs away contentedly. This puffing is caused by the swallowing of air. The frog has no ribs, and is obliged to take in mouthfuls of air, swallow it, and force it into the lungs If a frog's mouth were held open too long it would be suffocated, even though its skin is also capable of absorbing a large quantity of both air and water.

For some reason best known to themselves, frogs and toads are not happy in each other's company ; they are seldom seen together. Otherwise, there are a hundred points o difference by which they might immediately be distinguished. A toad always squats lower on the ground than a frog ; its head is also huddled down between its fore-legs. When it is touched or otherwise disturbed, it turns quickly aside and waddles away ; it can jump, but it much prefers to waddle, and it can do this very quickly. If you touch a frog it sits bolt upright and stares at you, and suddenly it takes a huge, startlingly long leap. It is able to jump fifty times its own length. A good way to visualize this enormous jump is to compare it with a man's jump over a wall a hundred feet high.

The toad's body has a swollen appearance all over, and the head is flattened. There are swellings over the eyes, and the nose or muzzle is more rounded or blunt than that of the frog, whose head is nearly triangular in shape. The hind-legs of the frog are more than half as long again as the body ; those of the toad are noticeably shorter. The body of the latter is covered with little warts, which give it a very repulsive appearance, whereas the frog is always rather handsome and quite clean-looking. The frog may be spotted but his skin looks smooth ; it is usually brownish or yellowish-brown, occasionally very dark with black spots ; there is a patch of dark colour on the temples and there are generally two indistinct pale dorsal lines.

There are in reality very many differences, throughout life, from the egg-chains of the toad and the egg-masses of the frog, to the toothless toad and the frog with teeth in the upper jaw and across the palate. The tongue of the frog is lobed at the tip, but that of the toad is entire. Toad-tadpoles differ from frog-tadpoles in that they are smaller, much darker in colour, and rounder in shape. But one of the fundamental differences is connected with the toad's skin exudations, which are admitted to be of a very injurious nature. What precisely the poison consists of may not be quite certainly known, but it is probably of an excrementitious character, and, as such, may be of use in supplementing the action of the lungs in carrying off a portion of carbon from the blood. It is inflammable and acrid, and, therefore, distasteful to most birds and animals, though it is known that hedgehogs will readily devour toads ; this latter fact shatters the theory that the sole purpose of the exudation is to provide a protection for the toad against carnivorous

A photograph of a young Toad showing its warty back, its distinguishing characteristic.

A young, fully developed Frog, with his tail quite gone, trying to climb to liberty.

enemies. Experiments show that it is both caustic and bitter, that it has a disagreeable, poisonous smell, and a yellowish colour; that, exposed to the air, it becomes solid, and, placed on glass, scaly in appearance. Experiments have also been made with a view to testing its effect on birds and animals, and the results have been sinister and decisive. Linnets and finches, inoculated with the viscid, milky fluid, have died in a few minutes; dogs, guinea-pigs, goats and frogs, similarly inoculated, have collapsed and died within two hours. With regard to the frogs, they died when the fluid was only placed on their bodies; this might be expected to happen, as their skins are so remarkably absorbent. Toads themselves, on the other hand, were quite unaffected by it.

It is on record that a child died from being poisoned by these exudations from a toad that he had taken out of a hole. It is possible. But it is also certain that there have been people killed by wasp stings. The outcome depended in both cases on the state of the blood of the person poisoned, and not on the potency of the poison itself.

Is it true that toads can live inside rocks, with neither air nor food? Assuredly it is not true. It has never been satisfactorily proved that the toads that have hopped out of broken rocks and stones have had absolutely no access to the air.

What has certainly happened more than once is this: very young toads have been washed down into fissures in rocks in stone quarries. The flood that washed the toad down will also wash down after it tiny specimens of insect life on which it can feed; this will happen again and again, and the toad, if it has space enough, will grow; if not, it will die, and nothing further will be seen of it. If it lives, sooner or later a workman may split the rock and release it. The fissure by that time may be almost invisible, filled up with earth and powdered stone and clay; the workman will see the toad, but he will never notice the crack in the rock that admitted the toad. Toads can exist on very little food, provided they do not take exercise; and a toad that had found its way into the heart of a rock by means of a crack would live for a long time in a fairly healthy condition.

Frogs and toads are alike in one matter, they can both easily be tamed up to a certain degree. Flies, and small, quickly moving worms are the best means to employ. Toads are also very sensitive to music, and will come into a room to listen to it. Both seem to like the sound of the human voice. One frog of my acquaintance used to come and sit listening to our voices as we talked in the porch in the evenings. His favourite place was under a garden bench, and he would probably never have been noticed if, one night, he had not come right out and sat boldly in front of us.

A young Frog takes his first outlook on the real world.

# Wild Flowers and Their Ways

## 1.—THE WILD RELATIONS OF THE CHRISTMAS ROSE

By EDWARD STEP, F.L.S.

With photographs by the Author

THE handsome plant that bears the name of Christmas rose is familiar to all who love the old-fashioned garden ; but comparatively few nature lovers have had the good fortune to come upon its two wild relations—the stinking hellebore, or setterwort, and the green hellebore, or bear's-foot—in their natural haunts. As British plants their range is restricted to the eastern and southern districts of England alone. In other parts they have been introduced here and there, and on suitable soils have become naturalized—the suitable soil being chalk.

My own localities for these plants are on the North Downs in Surrey ; in one case the more open edge of a beech " hanger," where the striking clumps of setterwort have as companion plants the spurge laurel, the deadly nightshade and the purple helleborine. Although only a herb, its stems are perennial and the leaves continue green through the winter. The stems are from one to two feet in height, bare below in old plants, but crowned with a wide-spreading head of very dark green, leathery leaves. Each leaf is about six inches across, and cut into a number of slender leaflets. It is a good example of that form of compound leaf known as pedate, wherein the pairs of leaflets that are nearest to the base spring from separate branches of the leaf-stalk. Late in the year new shoots of a pale yellow tint issue from the crown of upper leaves, breaking gradually into large clusters of stout flower-buds, which are evident in December but do not open until February. It is best sought early in the year, for then the new growths make the plant conspicuous from a distance.

The opening of the Setterwort's flowers is marked at one stage by the development of a line of crimson along the edges of the outer sepals. Later, this line becomes broader and of a purple tinge. It has been thought that the line of colour may be intended as an attraction for flies in quest of pollen, failing the visits of bees.

To understand the setterwort's flowers we must see them from the beginning, before

Two of the flask-shaped petals are seen in the open flowers of the Setterwort.

they are well open. The showy portion of the drooping flower consists of five pale greenish-yellow sepals. The five petals are not visible, though they are present in the form of little green two-lipped tubes half filled with nectar. The pistils are hidden also, save for the curved awl-shaped styles in the midst of a crowd of stamens which are arranged in four ranks. At first the tips of the sepals part very slightly, the small opening revealing only the two or three curved stigmas above the closely pressed, and as yet immature, anthers. Early honey-bees and humble-bees visit the flower for the nectar, and in pushing in their tongues to reach the tubular petals that contain it, press their heads against the stigmas. In this way cross-fertilization may be effected by pollen brought from more advanced flowers. After fertilization the filaments of the stamens lengthen, so as to raise the anthers above the stigmas. The anthers are now less closely packed; they have spread as the sepals have parted more widely, and the pollen is now discharged. Visiting insects —which also include drone flies in quest of pollen—alight on the anthers to get at nectar or pollen, and so dust their lower surface with the pollen, in this way conveying it to the stigmas of newly opened flowers. At this stage the outer sepals develop a line of crimson along their edges and, after the emptying of the anther cells, this line becomes broader and more purple.

The object of this line of colour is not clear, but it may be construed as an attraction for flies, failing the visits of bees. As already mentioned, the drone fly is one of

At midsummer the Setterwort is seen in fruit. In this photograph the upper capsules are fully ripe; one, to the left, has discharged its seeds in a mass which is caught on a bract below.

the visitors in quest of pollen, and by so doing it may effect cross-fertilization. The fact that the coloured margin is not developed—so far as my observations go—until the flower has been open for several days, indicates that it is not present as a signal for bees. It is a tint that marks many

detect that likeness, though I have tried hard to do so. But my friend Mr. T. A. Dymes has found that snails are fond of the connecting strip, and in eating it, of course, they separate the seeds, and some, no doubt, by sticking to the slimy body of the snail are carried for a distance. It is also

The Bear's-foot grows thickly in and around fairly dense copses in the south and east of England, although single specimens may be found growing in adjoining rides.

of the flowers that are fertilized by carrion-loving flies.

After fertilization the pistils develop into two or three large, beaked bags containing the seeds, which do not ripen until about midsummer ; and the sepals—now spreading widely—remain until after the seeds have been shed. The seed-vessel splits along its upper edge, disclosing two rows of large, black, wrinkled seeds ; and when these are quite ripe they fall out in a cluster of about a dozen. They are all attached to a thick strip of oily tissue, and some observers have fancied they have seen a likeness in the entire mass to the larva of some beetle, and that this purports to delude an insect-eating bird into carrying it off and so distributing the seeds. I could never

well attested that certain ants appreciate it as food, and either drag the entire mass or portions of it to their tunnels, where the strip is eaten off, and the seeds are in a suitable situation for germinating.

After the seeds have fallen, the flower-bearing shoots wither and fall away from the rosette of perennial leaves. The entire plant has the fetid odour indicated by its name, and this probably prevents its consumption by browsing animals. Formerly, it was used as a medicine, and to this fact may be due its presence in some localities, plants now growing wild being the descendants of those grown in old gardens. It had a reputation for curing various forms of mania, and the dried leaves reduced to powder were administered as a vermifuge ;

The flowers of the Bear's-foot have beautiful bright green sepals, and each measures about two inches across. The sepal spread widely and almost flat from the first.

but it was a dangerous remedy and has been abandoned. The long branches of the root-stock were used as setons, and thrust through the dewlaps of cattle, according to a very ancient belief that this treatment rendered the animals immune to murrain and other cattle diseases. Culpeper says of a similar use, "If a beast be troubled with a cough, or have taken any poison, they bore a hole through his ear, and put a piece of the root in it, this will help him in twenty-four hours' time."

The bear's-foot, or green hellebore, though in some respects similar, is yet so strikingly different that the two species cannot be confused. In autumn there is little evidence above ground of the plant's existence below. All that remains is an imperfect leaf or two, dry and faded. Its permanent parts are hidden in the leaf-mould. At the end of December or beginning of January it begins to push up its annual flowering shoot, which attains a height of a foot or two feet. The leaves on this flowering stem are without footstalks. There are but three or four flower-buds to each stem, and these have separate stalks. Larger leaves, with stalks springing directly from the ground, make their appearance soon after the flower-stems, but they do not expand and attain their full handsome proportions until after the flowers have opened. The flowers have beautiful bright green sepals, and each measures about two inches across; whereas, green flowers as a rule are very small. The sepals spread widely and almost flat from the first. When the flowers open, the nectaries (petals) are closed, but the stigmas are mature and susceptible to pollen brought from another flower, and remain so until the first row of stamens discharge their pollen—so that self-pollination is a possibility. The awl-shaped styles are in this species long, straight and slender, instead of being curved as in the setterwort. The flowers do not droop nearly so much as those of the setterwort; but like the latter they are succeeded by two or three large seed-vessels filled with

Similarly to the Setterwort, the large seed capsules of the Bear's-foot succeed the flowers, but are filled with smooth black seeds, which drop out separately.

black seeds that are quite smooth, and that drop out separately.

The fine, large radical leaves are somewhat similar to those of the setterwort, but they are digitate instead of being pedate — that is, all the toothed leaflets spring directly from the top of the leafstalk.

The bear's-foot is more widely distributed in this country than the setterwort, though still restricted to the south and east of England, and where it occurs it is in greater abundance of plants. This appears to indicate that its system of scattering its seeds loosely is a better one than bribing snails and ants to sow them. The smooth, unwrinkled seeds, too, may be more certain of slipping over foliage to the earth. In my own — geographically — limited acquaintance with the two plants I have found the setterwort scattered about the open margins of beechwoods and adjoining pastures, whilst the bear's-foot plants grow thickly in and around fairly dense copses. It is true that single specimens growing in adjoining rides — a sort of overflow from the copse — were more finely developed.

The hellebores are included by botanists in the natural order *Ranunculaceæ* with the buttercups, anemones and columbines. The setterwort (*Helleborus fœtidus*) is also a native of western Europe whose northward range stops at Belgium. The bear's-foot (*Helleborus viridis*) has its headquarters around the Mediterranean, whence it extends sparingly as far north as Holland; but the English plants are not of the typical form, and they have been distinguished as the variety *occidentalis* of Reuter.

There are numerous exotic hellebores, several of them besides the Christmas rose being grown in our gardens, but all of them are, as wild plants, restricted in their range to Europe and the adjacent parts of Asia. Some of these have rosy or purple flowers. In connexion with the development of a line of colour on the sepals of the setterwort, it is of interest to note that the white flowers of the Christmas rose turn green after they have been fertilized, possibly as an indication to visiting insects that the nectar has been exhausted.

This close-up view of the Bear's-foot at home shows the fine large radical leaves. They are somewhat similar to those of the Setterwort, but all the toothed leaflets spring directly from the top of the leafstalk.

# Our Wild Animals at Home

The Otter is an expert fisherman, and the thrill of capture when he gets his teeth into a fish is plainly to be seen in his triumphant attitude and expression.

## 1.—THE SILENT FISHERMAN OF OUR RIVERS: THE OTTER

By DR. FRANCIS WARD, F.Z.S.

With photographs by the Author

IT is usual to think of him as a poor, persecuted vagrant; shot, trapped, and hunted by keeper, water-bailiff or otter-hound. But the otter is a sagacious beast, and, thanks to his cunning and to the fact that he is ever on the move, it is only now and then that he falls a victim to his enemies.

Personally, I look upon the life of an otter as one of the best, and if I had to choose my after-life transmigration into the animal world, I should elect to be *Lutra vulgaris*.

During the night the members of the family hunt and fish, first for food and then for sport, romping and frolicking until the dawn. Then, by sunrise, they holt up and sleep peacefully, while man toils through the heat of the day.

Though cubs may be born any time during the year, it is more often in the spring that otters whelp. A litter generally numbers two to four; sometimes there are five, and there is a record of a litter of six found on the banks of the Moselle on July 26, 1911. The usual number, however, is three.

When the young are due, the mother otter makes a nest which she lines with dry grass and other soft material. Sometimes the spot selected appears to be in a very public place. I have found cubs in the hollow of a willow tree quite near a footpath. At times a hole in the bank of a river is

"WHO GOES THERE?"

**An Otter on the alert**

*Photograph by Dr. Francis Ward*

"ALL CLEAR?"

A Little Owl in its retreat

*Photograph by Captain C. W. R. Knight*

THE GATHERING STORM

A Rook breaking off twigs for "nest-lining"

*Photograph by Stanley Crook*

IN THE PINE WOOD

*Photograph by Captain C. W. R. Knight*

chosen, or a cleft in the rocks where anglers constantly pass. But more frequently she selects a sheltered nook in a bog, or a dense patch in the centre of an osier bed. In all cases the nest is not far from water.

Otter cubs are restless animals, and soon after their eyes are opened they tend to stray. When the parent is away on a foraging excursion a cub will often leave the nest, or hover, and wander off. Cautiously he crawls along, fearful of the strange world around him. But he does not get far; the mother on her return rapidly follows up the truant. He tries to escape, but she inflicts well-deserved punishment by a sharp bite on the back of the neck, and then carries him home.

When older, the family is permitted to gambol in the meadow by the river-side, and the antics of young otters are as quick and charming as those of kittens. The otter is a most playful animal, and the play instinct lasts right into adult life; full-grown otters often meet after their fishing to gambol and frolic together like cubs.

This beast is a near relative of the badger, pine marten, stoat, weasel and ferret, and originally led a purely terrestrial life. It is in more recent times that he has become a fisherman, and now both hands and feet are webbed, while the tail has become a powerful rudder. Though still an active animal on land, his agility under water is remarkable.

Young otters do not, however, take instinctively to the water; it often requires considerable persuasion on the part of the parent before they will enter a stream. Not infrequently, indeed, they have to be pushed in.

Instruction in fishing begins as soon as the cubs are at home in the water. To encourage them, the mother first lays at their feet a flapping fish, over which they hiss and squabble; then she induces them to quarter the water and search for further food themselves under the banks and boulders.

At first the otters stay by the stream near which they were whelped, and in which waters they learnt to swim and fish, but after two or three months of home-life the mother decides to take her progeny farther afield. Let us follow the night ramblings of a family.

A Female Otter disturbed on entering the water. She is still hanging on to the shore by her tail.

They had hovered in a cleft between rocks on the banks of a northern stream. An hour before it was dark the mother looked out. It was yet too light to sally forth, so

she withdrew to wait another hour. As the darkness spread she again looked out, and this time slipped into the water. Presently her head appeared in mid-stream. She had a good look round, and then paddled across to the opposite bank. Here she stood on her hind-legs to see if the coast was clear. Satisfied, she paddled back to her family, and soon reappeared followed by the cubs.

In reconnoitring the ground before proceeding on a fishing expedition, the Otter exercises the maximum of caution.

For a few minutes they swam and frolicked in the water. Then the mother landed, and in otter-voice, half whine, half whistle, she called them up. Away they went across country. After travelling a mile or more the party again struck the river, just where two streams came together forming a long, deep pool. When the otters arrived the pool was full of fish ; sea-trout, with perhaps a salmon or two as well. This is where the mother had killed her first sea fish, and here she brought her cubs that they might know the same thrill that she had experienced long ago, when she first got her teeth into a fresh run sea-trout and landed her first salmon.

Taking up a central position, with the young otters on either side, she waded into the water. Keeping in line across the stream, as they had been taught to do in the lower waters, the cubs followed. Then, simultaneously, at some signal which I have never been able to detect, they dived, and, as they swam under water, drove the fish before them. A fine sea-trout suddenly doubled back past a male cub. He detached himself from the advancing line and diligently searched under the stones and boulders for his prey. Presently he flushed his fish, which, like a flash, shot down-stream. With a swish of hindquarters and rudder in one, he turned as if on a pivot, and dashed after the sea-trout. No longer now were forepaws tucked up by his side while the powerful hind-legs did the work. In this mad chase all four limbs were in use as he twisted and turned and dived after his prey. Finally, under a boulder, came the end ; the sea-trout fell a victim to his fleet pursuer, who, seizing it in his powerful jaws, bore it ashore in triumph. As he landed, one of the female cubs came up to vent, she spotted her brother's good luck and joined him, hoping to share the spoil. But no ! the catch was his, and his sister might hunt for herself. With a fierce snap at her head he went for her and drove her back into the water. Both Might and Right being against her she acquiesced and rejoined her mother. The hunt went on, and, thanks to a

ALL THAT AN OTTER LEFT OF A TWO-POUND SEA-TROUT.

(1) In eating a fish the otter starts at the head, devours the skull, body, and tail, and finishes with the caudal fin. (2) The otter, during the meal, stops for an occasional drink. (3) All that was left of a two-pound sea-trout was but a few scales and some splashes of blood. The otter is clinging to the boulder with her tail.

In searching for fish the Otter will cling to the shore by his tail, and thus support the weight of the body. By this method he is enabled to slip noiselessly into the stream.

fine run of sea-trout, all four otters were soon busy chewing their fish.

There is an idea, popular amongst sportsmen, that the otter is a fanciful feeder. He is accused of catching trout or salmon merely to devour a portion out of the shoulder.

There never was a greater fallacy. When hungry, otters devour whatever comes along—frogs, dead fish, fowls or anything else; they will even gnaw roots and nibble vegetation. In the case of fish, they start at the head, devour the skull, body and tail, finishing up with the caudal fin. This is well illustrated in the series of photographs, "All that an otter left of a two-pound sea-trout." It will be seen that the

The Otter, here photographed under water, uses only the hind-legs as he swims—

—twists and dives in his search for fish.

mother otter stopped for an occasional drink, but at the end of the meal nothing was left to indicate the scene of her repast but a few scales and some splashes of blood.

When otters are satisfied, however, then they will hunt for sport. Bringing their captures ashore, they now only bite a piece out of the shoulder and return at once to the game. This love of hunting in the otter is most

marked, and if he happens to get into a fish hatchery his sporting instincts may be somewhat expensive to the owner. As an example, one night three otters visited the ponds of the Solway Fishery Company and killed two thousand yearlings. One can imagine how these beasts saw red as they raced through the water amongst their myriad prey!

How is it that an animal weighing between twenty and thirty pounds can enter the water without a sound and with scarce a ripple? The explanation is that at the waterside the otter clings to the shore with his tail. The weight of the beast is thus held up, and the entrance into the water is a rapid glide instead of a jump, as in the case, say, of a dog. There are three illustrations showing an otter entering the water. It is obvious that in each instance the otter is holding up its weight with the tail, and so is enabled to slip noiselessly into the stream.

After satisfying their hunger, our otter family killed a fish or two more, and then turned their thoughts to play. One moment on the bank, the next in mid-stream, they chased, sparred and wrestled, while now and again a pair locked in a friendly embrace would roll over and over in the water like a ball. The mother presently retired to the bank and began to rub the back of her neck in the gravel to rid herself of the ticks that she could not reach with her teeth. But soon the sight of her family playing in the water was too much for her, and she rejoined them in their revels. After an hour or so of play, the otter called her cubs and took them up-stream, to a place where the river came down like a spout between big rocks.

At the top of the fall the otter slipped into the swirling current, to appear again some thirty feet below. The cubs followed, and up and down they went, thoroughly enjoying the excitement of this new game.

To slide is also a great delight to the otter. On the banks of the Hodder, I have seen a snow-slide, frozen hard. On one side the snow was trodden down and showed the five-toed "seal" of the otter. The otters had evidently gone up and down for hours, walking up on the one track, and tobogganing down, flat on their stomachs, head-first into the water.

These animals will also make a slide on land. Describing such a one, W. J. Long says: "This slide was twenty feet high and made with great care on the side of a promontory that jutted into the river. Here a pair of otters spent the better part of a sunny afternoon sliding down a clay bank with endless delight." This was certainly

This series of Kinema-photographs shows the Otter's marvellous agility in playing with his prey—a pike which it is pursuing and eventually captures by the head.

a warmer form of amusement than plunging into an icy river off a snow-slide at night.

In Britain otters have become nocturnal in their habits in fear of man, but in many less inhabited parts of the world they move about as much by day as by night.

While the otter family were engaged in plunging down the waterspout the sun had tinged the sky. As soon as the mother noted the glow of dawn, she again called up her cubs, for they must be led to a safe hover in which to pass the dangerous hours of daylight.

Paddling, floating, and swimming, whistling to each other at times as if to say: "Are you there?" they dropped downstream, travelling quickly, for it was growing light. Presently, when the sun swung up, the mother grew agitated and, forcing the pace, bustled her family along. Suddenly she turned right-handed and hurried the cubs up a backwater. Here was a drain they could creep into, dry and cosy, with room for all to sleep. In safety, then, they settled down to the task of cleaning their pelts before sleep. First they pulled burrs and other vegetation out of their fur, next licked themselves all over, and then, the toilet completed, they curled themselves up and slept throughout the day.

What of the dog otter—the father of the family whose wanderings have been described? When she was whelping and the cubs were young, he would have died in their defence; yet when the cubs were not more than four months old the roving spirit took possession of him and he wandered off. Lying up by day, and travelling ten to fifteen miles by night, he soon reached the head-waters of the river. Here the spawning salmon and trout afforded him easy prey. He journeyed on until the river was but a tiny stream which gathered its waters from a boggy morass overgrown with coarse grass and cotton-plant. There were no fish here, so the traveller had to feed on frogs and young birds.

He now followed a trickle of water which had its origin at the other end of the morass. This, gathering strength as it picked up tributaries on its course, became the river of a new watershed. *Lutra vulgaris* now returned to a fish diet, but the roving spirit was still upon him and he continued his journey towards the sea.

At last he arrived at a fishing village. At dead of night he slipped through, and at dawn he was fishing in salt water. Here he was quite as much at home as in river or lake. By day he hovered among the rocks; at dusk and in the early morning he fed on flat-fish, rock cod, bass and crabs. With the advent of spring he returned to find another mate.

When the parent is away on a foraging excursion a cub Otter will often leave the nest and wander off, but he does not get far. The mother on her return rapidly follows the truant and, after inflicting a punishing bite on the back of the neck, carries him home.

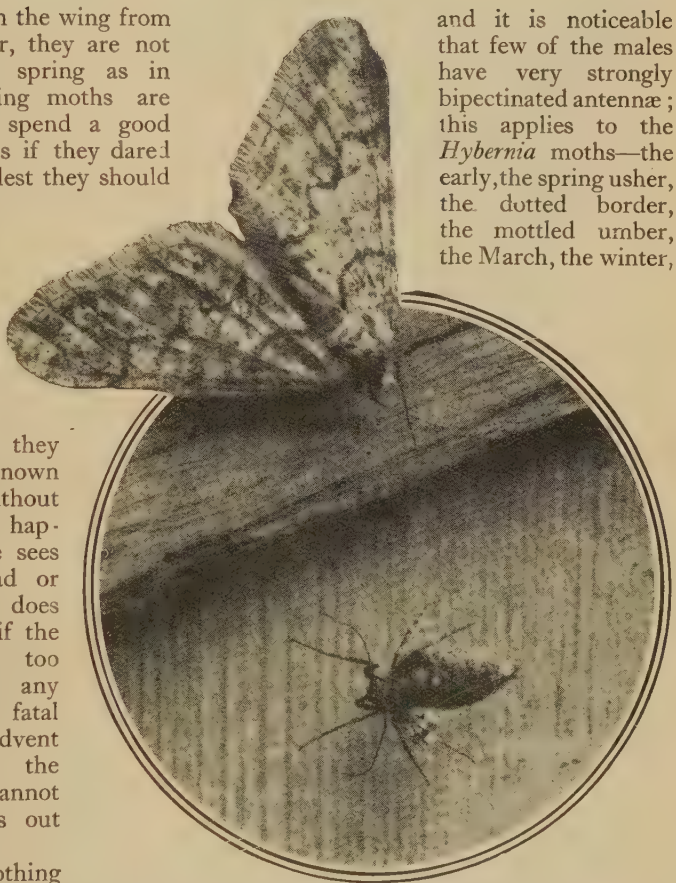
# Curiosities of Insect Life

## 1.—THE MOTHS OF SPRING

By M. H. CRAWFORD

With photographs by the Author

THOUGH moths are on the wing from January to December, they are not so easily found in spring as in summer. Winter and spring moths are very quiet creatures, and spend a good part of their time resting, as if they dared not take too much exercise lest they should exhaust their very small amount of vitality and be unable to renew it. Extreme quiescence is particularly noticeable in the female moths; they are even quieter than the males. They take life precisely as they find it; if it does not suit them they pass away, out into the unknown whence they came, without struggle or protest. The haphazard egg-laying that one sees so often amongst half-dead or injured moths in summer does not take place in spring; if the weather is too damp or too stormy, or if mating for any reason is delayed, then the fatal sleepiness sets in, and the advent of propitious weather or the tardy arrival of a mate cannot rouse the moth; she goes out without laying her eggs.



The Spring Usher (*Hybernia leucopharia*) male and female (below). The latter displays the little brown and white fringes that are all the wings she has. Few of the males have very strong bipectinated antennæ.

Though we know nothing about the way moths find their mates, it seems as if heavily fringed antennæ were given to those males who have any special difficulty in the matter. The early spring moths and those emerging in winter have unusually mild and stay-at-home little mates, some of which are wingless, and others partially so; it is a simple matter for the males to find them, and it is noticeable that few of the males have very strongly bipectinated antennæ; this applies to the *Hybernia* moths—the early, the spring usher, the dotted border, the mottled umber, the March, the winter, and the northern winter. There is an exception in the case of the small eggar, which flies in February and March; the antennæ of the male are bipectinated, but then he has a very active mate, and he

belongs to a family in which the females are frequently larger than the males. Another exception is the pale brindled beauty moth which flies in March ; the female is without

In April the Kentish Glory (*Endromis versicolor*), a most beautiful British moth, appears. The female, which is here shown, is considerably larger than the male, and both sexes are splendid in all their stages.

wings, but anyone who has seen her walking, and noticed her six strong, capable legs, will agree that she may take as much finding as the small eggar ; in this case, too, the male's antennæ are bipectinated. In April the Kentish glory appears ; this is one of the most lovely of all British moths, and as the female is considerably the larger, the male probably needs all the assistance his heavily fringed antennæ can give him.

The Kentish glory is splendid in all its stages. I have found the eggs in April on a hazel twig, pale green in colour, gradually turning darker within a day or so. The larvæ are green, with longitudinal cream or pale yellow stripes ; they have a curious habit of resting with their heads thrown up. Towards the end of summer they make their cocoons of leaves and caterpillar silk, and in these cocoons the dark brown pupæ rest till spring.

Besides their usually quiet and retiring dispositions, the spring moths are often remarkable for their protective coloration or shape. The photograph of the waved umber gives a good example of this. No matter what wood it happens to rest on—a tree trunk, a fence, or an outhouse door,—it falls into perfect harmony with its surroundings. Its wing colorations are black, brown and reddish brown ; the hind-wings are dentated, the triangular fore-wings have rounded hinder angles with acutely cut apices, and when these are held flat against the wood the margins give no

The Eggs of the Kentish Glory Moth may be found laid in April on hazel, birch or alder twigs ; they are at first pale green in colour but gradually darken within a day or two.

distinct line anywhere. Just as difficult to see are the pupa cases which are formed sometimes between the leaves, but are often laid along a twig or branch, so that it is quite impossible to detect any difference between the brown parchment-like cocoon

The Waved Umber Moth (*Hemerophila abruptaria*) is almost impossible to see because it rests on fences and tree trunks in the daytime. It affords a good example of protective coloration. No matter where it may rest on wood, it falls into perfect harmony with its surroundings.

and the bark. A small crevice or fork is chosen, and the cocoon is made just to fill up the crevice, or bridge over the angle of the fork. This moth belongs to the tribe of *Geometers*, and its larvæ are extremely active little brown loopers. They are so precisely like tiny twigs that no danger from attack by birds would seem to beset them. They have small dark brown heads, narrower than the body, and the various tubercles have the exact appearance of buds or twig excrescences.

The two interesting little orange underwings fly by day, and have, therefore, need of protective coloration. They come out during March and April, and are found round birch, willow, poplar, and beech trees. *Brephos parthenias* especially likes to fly in sunlight. The forewings of both are brown, but those of the light orange are greyish, or dusted with grey; there are wavy transverse lines of reddish and black and pale brown. The hind-wings are covered completely by the forewings, and are of a beautiful orange colour, with darker margins and patches.

Another moth that is well protected by wing colouring is the yellow-horned moth. This is a much stouter moth than the two preceding; the antennæ are thick, and the head is covered with thick woolly hair. It often rests on the bark of birch trees, and the

The small Eggar Moth (*Eriogaster lanestris*) belongs to a family in which the females are frequently larger than the males. They fly in February and March, and the female is very active. The pupal state sometimes lasts for nine years.

pale, greenish-grey, white, and black-lined wings harmonize with the black and white markings of the bark. The tiny grey

The female Orange Underwing (*Brephos parthenias*) flies by day—especially in bright sunlight—during March and April.

caterpillars, which first appear in April, have little dots on each segment; as they grow older they become pale grey with black spots, but throughout their existence they are difficult to see, and hungry nestlings

Another day-flier is the Yellow-horned Moth (*Folyploca flavicornis*). The antennæ are thick, and the head is covered with thick woolly hair. Its pale greenish-grey, white and black-lined wings harmonize well with the bark of the birch, which it frequents.

miss a satisfying titbit when their parents overlook these larvæ.

Amongst the spring moths there are two especially that do harm in our gardens and orchards; these are the March moth and the cabbage moth. By the end of March the former has laid its eggs in neat rings round the twigs of plum and other trees. This moth has a little tuft of woolly down at the end of her body, and with this down she covers the eggs till they are embedded in it. In spite of the fact that she has no wings—not even visible rudiments of them—she is a rather pretty, smooth-coated, silky, grey little thing, with dark eyes and brown head. I do not know whether she

Like its neighbour, *Brephos parthenias*, the Light Orange Underwing (*Brephos Notha*) has need of protective coloration because it flies by day and frequents birch, willow, poplar, and beech trees. It is found in March in the northern counties.

lays her eggs all at one time; probably she does, though the number is enormous. She lays them in parallel rows along the small twigs, and these rows make a band that averages a quarter of an inch in breadth. There are about twenty-five rows and about fifteen eggs in each row, which means that she lays about 500 eggs at a time.

The bun-shaped, yellowish-white eggs of the cabbage moth are laid from about the end of April or the beginning of May, onwards through the whole summer to the end of August, and anyone who values dahlias, geraniums, red currants, cabbages and cauliflowers will destroy ruthlessly all the eggs found. They are not difficult to see, as they are laid in small batches on the undersides of the leaves. The larvæ hatch out in a few days, and are deservedly unpopular, both as to appearance and habits.

But the moth itself, when it breaks out of the shiny, chestnut-coloured pupa case, has fore-wings of a rich brown colour that

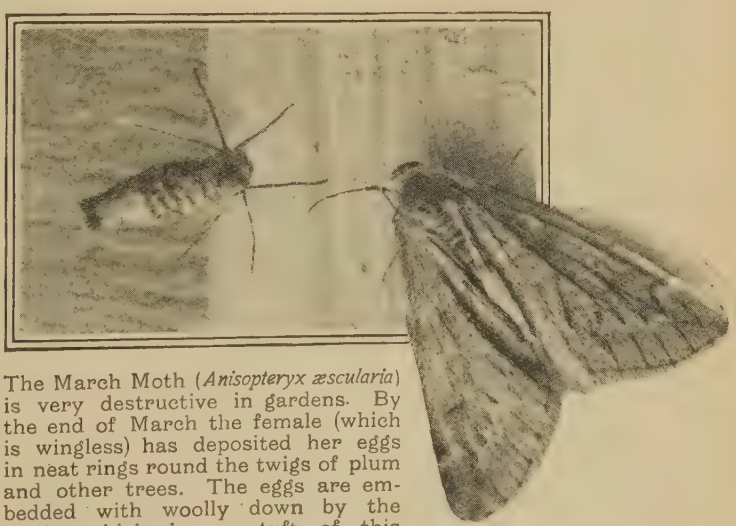
The Garden Carpet Moth (*Larentia fluctuata*) is a picturesque member of a large family which frequents plants in both the vegetable and flower gardens. The first brood flies in April, the second in August.

look as if they had been sprinkled with gold dust. This first appearance soon wears off, and the moths that are caught at dusk are usually way-worn insects, with frayed wings.

Of the large tribe of the carpet moths, one, the garden carpet, may often be seen hovering about plants in both vegetable and flower gardens. The eggs are laid on leaves of cabbages, nasturtiums and other plants, but the larvæ are not numerous and, therefore, cannot be counted amongst the pests ; otherwise, considering that there are two broods, one in April and the other in August, they would certainly go into the black list. All the carpets are exceedingly picturesque little moths, and the pattern on their fore-wings, as they rest on fences and tree trunks, is very striking. This pattern, however, is quite lost in a "set" specimen, and such a moth would hardly be recognized by anyone who had seen only the living insect.

A thorn moth is always a thing of beauty. There are many species, appearing at various times during the summer and autumn. The purple thorn flies in April and May, and the early thorn in March and April. A common characteristic of both is that they rest with the wings upright and vertical, like butterflies ; but they may be easily recognized as moths by their heavy, downy bodies and hairy antennæ. The fore-wings of the purple thorn are sharply angled, of a rich, purplish tinge, or sometimes a delicate rose colour. On each wing there is a crescent-shaped white lunule. All the margins are beautifully dentated. The head and thorax are brown, and the body is barred and downy. The caterpillar is almost as interesting as the moth, and may be found very soon after the eggs are laid on several kinds of trees, especially oak, ash, birch and beech. They belong to the *Geometers* and have many of the common eccentricities of the "loopers." The moths themselves often have the appearance of exquisitely coloured leaves, and the caterpillars look like the leaf-stems. While they are eating leaves they have a curious habit of poising themselves on the edges and on the twigs, and, as their colouring is a deep rich brown, with faint lighter patches, they pass very well as part of the leaves and stems.

The early thorn is less conspicuous in



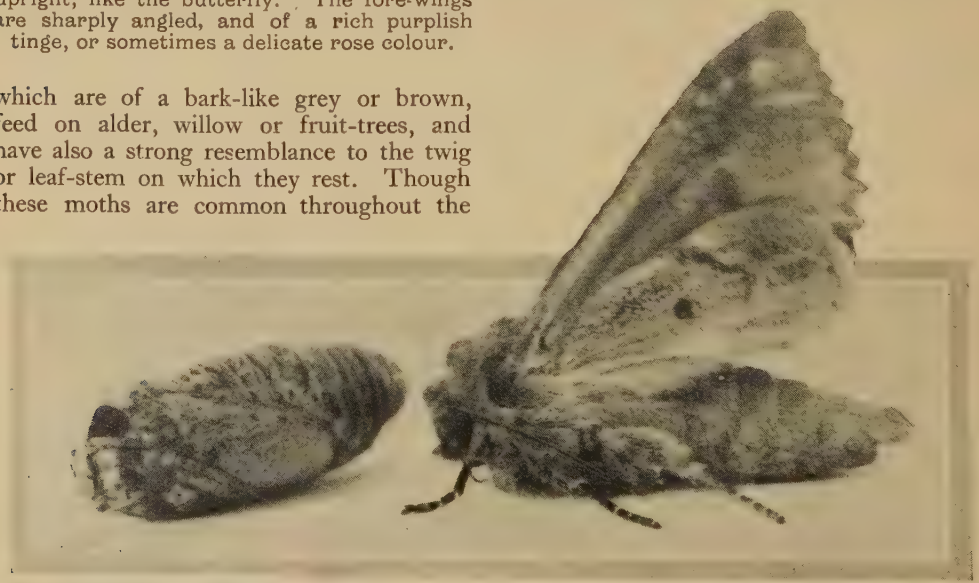
The March Moth (*Anisopteryx æscularia*) is very destructive in gardens. By the end of March the female (which is wingless) has deposited her eggs in neat rings round the twigs of plum and other trees. The eggs are embedded with woolly down by the moth, which has a tuft of this material at the end of her body.

colour, for its wings are of a pale ochreous-grey, which shades only slightly into violet, and the edges of the wings are less dentated than those of the purple variety. Its larvæ,

A young Purple Thorn Moth (*Selenia tetralunaria*) is always a thing of beauty. It flies in April and May, and comes to rest with wings upright, like the butterfly. The fore-wings are sharply angled, and of a rich purplish tinge, or sometimes a delicate rose colour.

which are of a bark-like grey or brown, feed on alder, willow or fruit-trees, and have also a strong resemblance to the twig or leaf-stem on which they rest. Though these moths are common throughout the British Isles, the larvæ do no harm. Closely related is the common brimstone moth, which also holds its wings vertical or half-raised, and is frequently mistaken for a butterfly. Indeed, in some ways the brimstone moth is not unlike the brimstone butterfly. Both appear occasionally as early in the year as February, though, of course, it must be remembered that the butterfly has hibernated through the first cold months and was born the previous summer, whilst the moth is young and just out of its chrysalis. Still, they are on the wing together; and even the shape and colour of their beautiful angled wings are much alike.

The real spring moths, plenty of them, active and plump, make red-letter days for the birds. When the last privet berry, the last of the hips and haws, even the last mistletoe berry, has been eaten by the hungry youngsters who were born nearly a year ago, then the first little fat downy bodies, creeping out into the light from their chrysalis cases, are hailed with glee, much as we ourselves hail the first spring lambs!



The Cabbage Moth (*M. Brassica*) beside its chestnut-coloured pupa case is at first a pretty species. Its fore-wings are of a rich brown, and look as if they had been dusted with gold; but this appearance soon wears off. This moth lays bun-shaped yellowish-white eggs, first about the end of April or the beginning of May, and continues laying till August. As a garden foe, it has few rivals.

# Trees and Their Life Story

*Photo: G. Clarke Nuttall.*

Larches in winter, growing on the buried walls of the old Roman City of Verulamium (St. Albans). Their tall loose pyramids are very decorative, especially when they stand silhouetted against the sky in a frieze-like row.

## 1.—TREES AND THE LANDSCAPE

By G. CLARKE NUTTALL, B.Sc.

THE aeroplane has brought an entirely new point of view into life—the study of landscape in bulk—and it has enriched our ideas about trees as it has about all the other features of the landscape. The swiftly moving traveller by car or train sees the trees from one point of view only, but the aeroplane passenger gets an infinite number of varying views, from the one right overhead which gives him a "plan," through every possible angle, down to the long, slanting view which is almost an "elevation." In these large views detail of all sorts is obliterated and only contour and shade tell, so that his perception of the trees of the countryside becomes purely a matter of form and colour. There lie the trees before him just pyramids and spires, needles and airy patches, great rounded heads with minor variations, crowns cut into segments, irregular oblongs and solid blocks. Dark green, light green, yellow and blue, some are recognizable with absolute certainty as familiar friends; others, like casual acquaintances, require further knowledge; while some appear as strangers needing a formal introduction from one who knows them.

In every community there are personalities which stand out, some for their greatness,

others for their peculiarities. So in the world of trees there are certain kinds of trees which, wherever they grow, are always an arresting feature in any landscape from larches that markedly change colour by discarding their summer dress of needle-like leaves. Firs, too, blue touched with silver, stand out pyramidal, though less

*Photo: G. Clarke Nutta'l.*

In winter as in summer the Oak stands acknowledged "Monarch of the Forest." Silhouetted against the sky in stark nakedness, its great outspread limbs zigzagging in "knees" and "elbows" give the impression of immense strength and endurance.

whatever aspect it is viewed. Thus the tall loose pyramids of the larches invariably catch the eye—pyramids formed by a central column straight and firm from which radiate slender horizontal or slightly falling branches, widely stretching at the bottom, but lessening little by little to the summit. Very decorative they are in spring-time touched with beautiful pale green colour, though in winter tending to become ragged and dead-looking. Then there are the pyramids of the spruces—grown-up Christmas trees—neat and trim-looking, with their dainty spire on top, somewhat denser and darker than the larches; and the solid pyramids of some of the cedars which are symmetrical cones like the wooden trees out of a Noah's Ark. The spruces and cedars are alike in summer and in winter; it is only the obviously so; indeed, all this class of cone-bearing trees is unmistakable, whether each stands alone or whether grouped in woods, but it is sometimes difficult to distinguish between them at a distance.

The Scots pine, our only true native among them, also starts life pyramidal wise, but tends to lose its lower branches, as a man loses his hair, so that ultimately it comes to have a tall bare trunk, with a picturesque flattened top of dark irregular boughs, that adds character to any landscape.

There is one immensely tall thin pyramid that can never be mistaken when it appears in the view, though it has nothing to do with the conifers, and that is the Lombardy poplar, a variety of the black poplar. Now the black poplar, a big loosely foliaged tree, has perhaps of all trees the stiffest, straightest branches, which rise upwards at a sharp

angle to the trunk, just like an arm of one of those jointed wooden Dutch dolls which have black painted hair and such very pink cheeks. In the Lombardy poplar this stiff acute-angle type of branching has been carried to an extreme, and the branches have shut up to the trunk as the ribs of a closed umbrella shut up to the stick. No other tree at all resembles it.

Next, perhaps, in the view we are taking, we should "spot" the airy irregular contour of the silver birches, for nothing can hide the gleaming silveriness of their trunks nor the "drip" of the ends of their branches.

When we turn to the greater forest trees careful discrimination is necessary. Now really to know a tree it is essential to regard it with definite attention throughout the year—summer in its leafage, winter in its stark nakedness. And, moreover, to see it set by itself where it can develop in every direction as its life force impels. It is best, too, to study it as it stands against the open sky, so that in summer its contour as a whole, and, in winter, every branch and twig may be silhouetted clearly on it. At both seasons the tree which stands pre-eminently in the picture is the oak, Jove's own tree, acknowledged "Monarch of the Forest." Its contour is a flat oval, broader than high, its trunk thick in proportion to its height, so that it has an air of immense solidarity. Its great branches, zigzagging in "knees" and "elbows," stretch out horizontally, and thus further emphasize the idea of strength and endurance. Indeed, as Oliver Wendell Holmes said, "this is the mother-idea of the oak." And he continued, "I wonder if you ever thought of the single mark of supremacy which distinguishes this tree from those around it. The others shirk the work of resisting gravity; the oak defies it. It chooses the horizontal direction for its limbs so that their whole weight may tell;

*Photo: G. Clarke Nuttall.*

The Oak in summer leafage defies gravity by choosing to develop its massive limbs in the horizontal direction, which for fifty or sixty feet will support the strain of the burden of leaves. Broader than tall, its trunk thick in proportion to its height, the Oak has an appearance of great solidarity.

**AN AERIAL VIEW OF A WOOD**

In striking contrast to the rounded crowns of the more massive trees, the delicate airiness of t
and the straggling clumps of Laurel, Hawthorn and Hazel le

*Photo: The Central Aerophoto Co., Ltd.*

**NDSCAPE, NEAR CHERTSEY, SURREY.**

ver Birch, the lightness of the more stiff-limbed Poplars, the solid dark pyramids of the Conifers, race and variety to the landscape as viewed from the air.

and then stretches them out fifty or sixty feet so that the strain may be mighty enough to be worth resisting . . . to start upwards would mark infirmity of purpose, to bend downwards weakness of organization." The thought is somewhat fanciful but contains a truth.

An oval contour, taller than broad, with a great sense of airiness and grace about it, branches have rather a pretty fashion of curving downwards and then up again towards their tips. The trunk is tall and rather slight considering the size of the tree.

Perhaps the commonest tree seen in any panorama of Great Britain is the common elm, a big tree possibly 125 feet high; its branches are dotted with smallish leaves and end in a network of fine

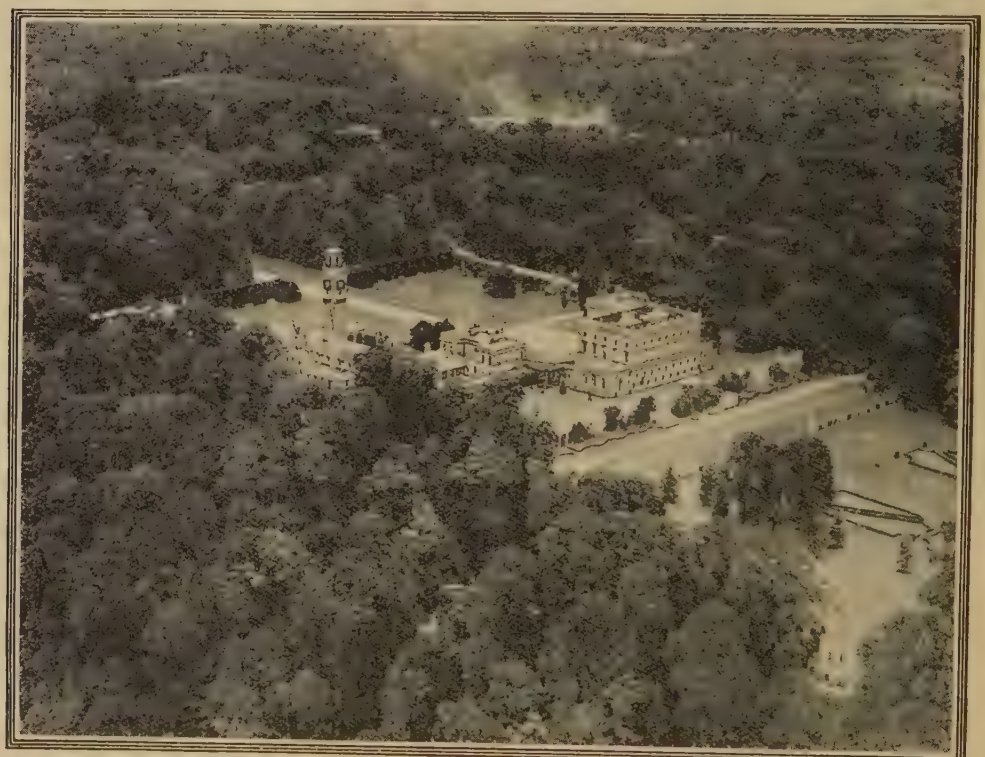


*Photo: The Central Aerophoto Co., Ltd.*

Density of foliage in the wide sweep of the woodlands, and distinctness of shape in the crown contours of the commoner trees seen in the less thickly planted groves, are the outstanding features brought to the ken of the aerial photographer. The Spruce and the Elm stand out unmistakably, but when the Beech, the Sycamore, the Horse and Spanish Chestnuts, and the Lime are grouped, it becomes increasingly difficult to distinguish between them from above. The view is of Viscount Astor's house, Cliveden, Bucks.

marks out the ash—is it not called the "Venus of the Forest"? There is nothing of the solidarity of the sturdy uncompromising oak here. Its foliage is somewhat of a lacework, and the sunshine gleams easily through it. This airiness and lightness is due to its leaves being cut up into little leaflets—usually nine—one being terminal and the other eight set in four pairs. Thus they do not solidly block out the sunlight as do the leaves of some of our trees. The twigs which, in winter, show almost as a haze round the crown. Indeed, this fringing of its contour is one of the distinguishing marks of the tree. Though so common that it has been likened to a weed in some parts of the land, it is not really a native, but probably came in with the Roman occupation, for its name, which dates from the earliest days, is directly derived from the Latin, *Ulmus*. A tree which perplexes by its likeness and yet unlikeness to the

*Photo: G. Clarke Nuttall.*

The Beech in winter nakedness is fairly easily recognised. Its rather fine branching seems often somewhat indeterminate, being full of twists and sharp turns as if it could not decide in which direction its twigs should grow.

common elm is the wych elm, for though elm-like in a general way at a first glance, its branching is fuller, its contour more regular, and its leaves larger. Though less frequent than the common elm it is considered a native of Great Britain.

When we come to those trees whose crowns are more or less regularly rounded — and in this particular the beech, the sycamore, horse and Spanish chestnuts, and the lime are grouped together—it becomes increasingly difficult to distinguish between them without the intimacies gained from a nearer view. That is to say, it is difficult when the leaves throng the branches; but in winter, when the bare system of branching stands revealed, recognition is much easier, and, of course, the trunk and its bark are almost infallible guides. The great crown of the beech is particularly dense and shade-giving —so dense indeed that little will grow beneath it. Its trunk is beautifully proportioned, with smooth dark grey bark, and, in the woods, it may be eighty feet high before it branches. Indeed, a beech wood, with its lovely smooth trunk columns, its dark brown carpet of dead leaves, and its reposeful dimness, might well be the aisle of some great Gothic cathedral. Out in the open the branching begins nearer the ground; in winter nakedness it seems rather to lack character, being angular, inelegant and full of twists and sharp turns as if the tree could not determine in which direction its twigs should grow. It is not so angular and stiff as the oak,

*Photo: G. Clarke Nuttall.*

In summer the great crown of the Beech is particularly dense and shade-giving—so dense, indeed, that little will grow beneath it. Its beautifully proportioned smooth grey trunk rises in the woods frequently to a height of eighty feet before it branches. Out in the open the branching begins nearer the ground.

*Photo: G. Clarke Nuttall.*

In winter the contour of the Common Elm, in addition to the emphasis which nakedness gives to its segmental outline, presents a network of fine twigs, which shows almost as a haze around its crown. Indeed, this fringing of its contour is one of the distinguishing marks of the tree.

of course, but undoubtedly it lacks suavity of line.

In the sycamore and horse chestnut the crowns are rather of a more voluptuous type ; the horse chestnut in particular is so ponderous, so reminiscent of a rich City man who does himself well, that once known it is for ever after unmistakable. The heavy head of foliage, through whose density little sunlight can penetrate, swells out here and there, giving it a " hummocky " appearance, and adding to the voluptuous impression. In summer silhouette it is just massed greenery lighted up for a short space by those wonderful spikes of white flowers, as a Christmas tree is lighted up by its

*Photo: G. Clarke Nuttall.*

The Common Elm in summer is quite unmistakable by its irregular contour, often broken up into segments. A big tree may be 125 feet high.

candles. In the winter the massiveness of its framework can be best appreciated, and the fact noted that sometimes its branches curve stiffly downwards and then up again. The heavy rounded crown of the sycamore is not quite so heavy or so impenetrable, for its silhouette reveals flashes of sunlight. The crown of the lime, though also heavy and dense, is distinguished by a peculiar compactness and neatness, while that of the sweet chestnut is far more broken up into segments and mounds than any of the four others.

In our study of tree form there yet remains one tree of special grandeur and massiveness to notice, one that stands out as none other in a landscape, pre-eminent in sombreness, density, and unchangeableness—an unchangeableness that through winter and summer has persisted, perchance, through more than a thousand years. This is the yew—the most ancient of trees. Of immense circumference though low in stature, it forms almost a blot in a panorama, and by its side all the lesser trees of the countryside—the hollies, the hawthorns, the rowans—seem insignificant and of little account.

The general form of individual trees being so variable, it follows that one gets very different and specially interesting effects of line and colour when trees of the same kind are collected into groups—for example, fir woods, beech woods, and so forth, and the groups viewed as a whole from above. Thus a fir wood, with its rows of dark points jutting up from the darker spread of the branches below, has a more or less military effect of erectness and alertness, and reminds one of a battalion of soldiers. A beech wood, on the contrary, presents an area covered with rounded green swellings—the tops of the crowns—closely touching each other like so many ant-hills, while the "plan" of an oak wood is made up of somewhat irregular ovals or oblongs of a rather paler colour. A very happy effect of colour and line is seen in the woods where pine and birch are intermingled. Here there are dark green patches, the tops of the pines, mixed with the light airy patches that denote the birches; indeed the whole wood is often fringed with the latter, for the birch is a lover of light and tends to escape to the edge of the wood.

Often the contour of the landscape is a great guide to the trees that are found in it. Thus, fringing streams and rivers are frequent lines of trees with grey-green airy crowns and angular branching. These are willows, and among them—of darker hue—may be alders. Then again, it is on the verdant slopes of the rich countryside that the beautiful rounded crown of the beech can be seen at its best. Flat meadow land specially appeals to the ash, but it dislikes sandy soil; the oak is happy in heavy and clay lands, while the birch and the pine love the open sandy spaces and wind-swept heaths.

Position, climate and, above all, degree of exposure are all great factors in tree form, for they bring about considerable modification of contour. Extreme instances of this can be seen in the gnarled dwarf oaks on Dartmoor, and the malformed birches of the sea-coast areas.

*Photo: G. Clarke Nuttall.*

No other tree at all resembles the Lombardy Poplar in contour. The stiff acute-angle branching of the Poplar has been carried to an extreme, and the branches have shut up to the trunk as the ribs of a closed umbrella shut up to the stick.

# 2.—WHAT IS PALM?

By G. CLARKE NUTTALL, B.Sc.

With photographs by the Author

The "palm"-bearing Goat Willow is the resplendent male of the species. In this photograph is seen the silver-bud stage of the male catkins.

FOR centuries past the country folk of these islands have gone to the goat willow (*Salix caprea*) to gather the so-called "palm" to decorate their churches and their homes on the Sunday next before Easter—

*"In Rome upon Palm Sunday*
*They bear true palms.*
*The cardinals bow reverently*
*And sing old psalms.*
*Elsewhere their psalms are sung*
*'Mid olive branches.*
*The holly bough supplies their place*
*Among the avalanches.*
*More northern climes must be content*
*With the sad willow."*

(GOETHE.)

There is, however, nothing sad about the "palm" of the willow, those long twigs set with golden, fluffy, globe-like catkins that mark the Sunday of acclamation. They shimmer in the pale spring sunshine, a scent of honey hangs about them, for honey lies in little sacs hidden among the golden spikes, and the bees, who always love sweetness and scent, murmur contentedly as they gather the golden dust. Indeed, a palm willow tree is one of the most beautiful sights of the early spring. As our Poet Laureate says:

*"The woodland willow stands, a lonely bush*
*Of nebulous gold.*
*There the spring goddess cowers in faint attire*
*Of frightened fire."*

But it must be a *palm* willow to carry this "nebulous gold" and "frightened fire," and not all the individual trees of the goat willow are "palm" willows. Herein has lain much perplexity for those casual observers who have not understood the ways of the willows.

Not far away from the "palm" willows are other goat willows decked, not with golden globes, but with narrow grey-green catkins demure and low in tone; most

The grey-green catkins of the soberer, less obtrusive female Goat Willow. Each catkin consists of a fleshy axis on which the flowers are set in a close spiral.

excellent foils in their likeness and yet unlikeness to the "palms." And this is the mystery of this small woodland tree — the inherent mystery of sex—for the "palm"-bearing goat willow is the resplendent male of the species, while the soberer, less obtrusive form is the female tree. Never in the willows of any species do the male and the female flowers grow on the same tree as they do in other kinds of trees (though the poplars and the yew follow the willows in their arrangements); always are they placed on different trees, hence each is complementary to the other and necessary to the propagation of the species by seed. So every goat willow is not a "palm" bearer, though "palm" comes always from a goat willow. Both kinds of catkins, whether they be the golden globes or the grey-green cylinders, consist each of a fleshy axis on which are set the flowers in a close spiral. The male flowers are just two stamens, like golden pins, standing on a dark scale which is edged with silver hairs; while the female flowers on the other catkins have a conical seed-case, instead of stamens, upon a similar silk-fringed scale. It is the fringes of these scales that, pressed together, make the silver "pussiness" of the buds of both kinds of trees in the very early spring.

The male flowers of the Goat Willow are just two stamens, like golden pins, standing on a dark scale which is edged with silver hairs.

*"O come into the hollow,*
*for Easter-tide is here,*
*And pale below the hillside the budding palms appear;*
*And silver buds a-blowing,*
*Their yellow blooms are showing*
*To woo the bee."*

(MARGARET DELAND.)

The bees by day and the moths by night are the emissaries of the goat willow and serve as intermediaries between the sexes, carrying the primrose-coloured fertilizing

A branch of the female Goat Willow with ripening fruit and leaves. The female flowers have a conical seed-case, instead of stamens, upon a silk-fringed scale.

pollen of the "palm" to the immature waiting seeds on the female trees and giving them the magic touch that starts them on fresh development.

As the weeks go by the crown of beauty subtly passes from the palm willow to its neighbour, for the once shining globes lose their gold, wither and fall away, but the seed-cases on the grey-green catkins swell into small blunt cones which, towards the end of May, split and curl backwards like a pair of ram's horns. Out of the opening pours a host of tiny dark seeds all crowned with a tuft of long silvery hairs. The whole grey-green catkin becomes a mass of silver down on which the little seeds float away with the breeze, passengers to worlds unknown. Presently they come to rest, deserted by the wind, or, perchance, held by some obstacle in their path. There they anchor by their long hairs, and, if the spot be to their taste—they like best a well-lighted forest clearing or chalky lowlands, but are very accommodating—they put out each a tentative root and at once start a new life that may result in a "palm"-bearing tree or, by equal chance, maybe the mother tree of the silvery down and the seed hostages for the future. It is now or never with this willow seedling; it must germinate at once or die. Nature's way is not, however, man's way with the goat willow. When he wants a new tree he takes cuttings from whichever sex of the willow he desires, and thus risks no chances with sex difficulties.

The goat willow, or sallow as it is sometimes called, is only a big bush or, at best, a small tree some thirty or so feet high—"a tree of a meane bigness," as an Elizabethan botanist quaintly described it. Its leaves are oval, often with a curious twisted tip, grey-green above, bluish and hoary beneath, and wrinkled like the face of a very old woman; but they do not come until the glory of the golden palm is past, though they companion the fruiting catkins during their period of transformation into silvery down. Bruised and boiled in wine, they, in common with the leaves of all willows, gave a favourite decoction to the old herbalists for the curing of all manner of ills; while, advises the Elizabethan sage, "the greene boughes with the leaves may very well be brought into chambers and set about the beds of those that be sicke of feuers, for they doe mightily coole the heate of the aire, which thing is a winderfull refreshing to the sicke Patients."

On the female Goat Willow the whole grey-green catkin becomes a mass of silver down on which the little seeds float away with the breeze, passengers to worlds unknown.

DOUBTFUL

A Fox faces the Camera

THE CHANGELING

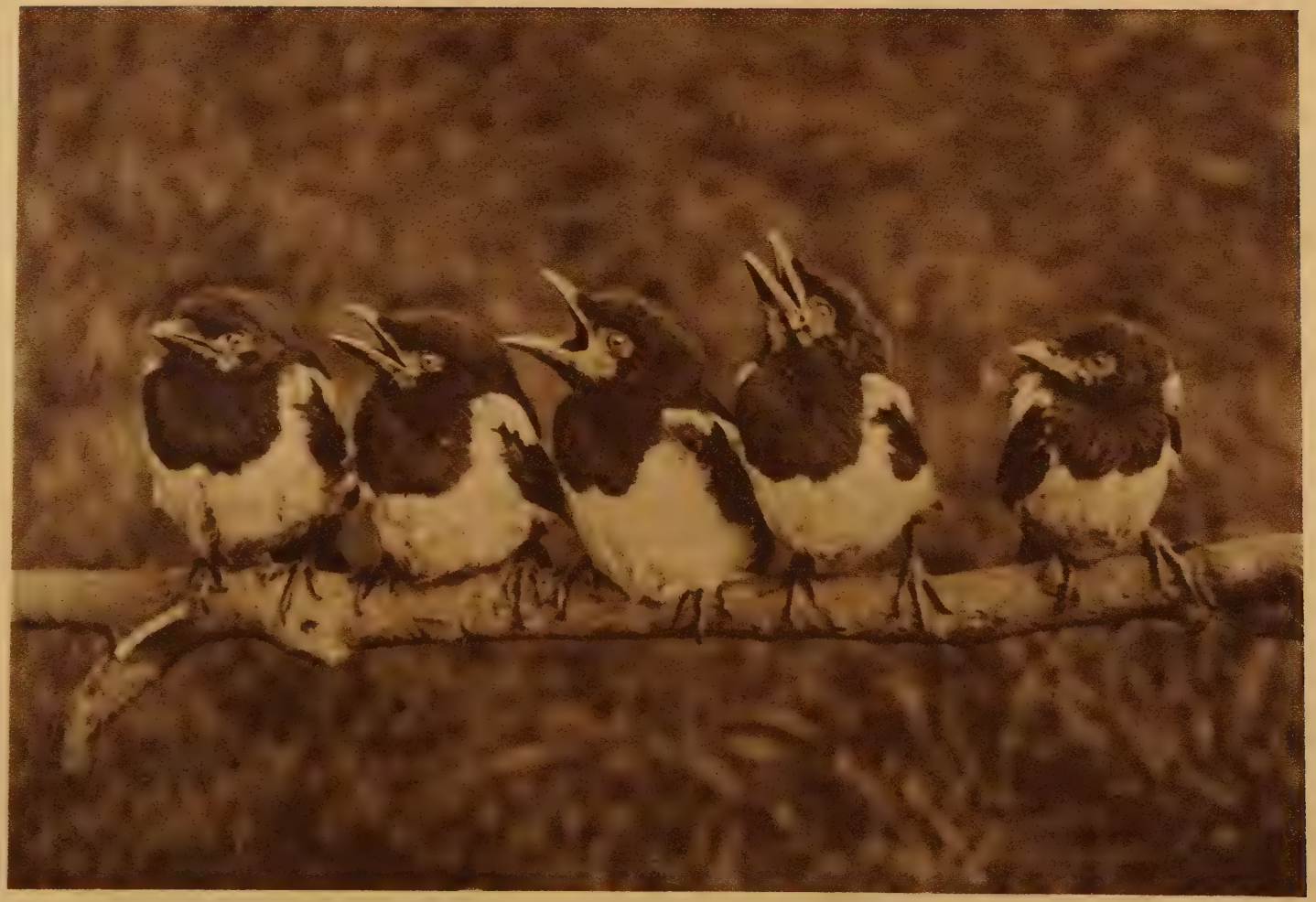
A young Cuckoo demanding "more" from its foster-parent, a Sedge-warbler

*Photograph by Captain Oliver G. Pike*

THE ONLY POISONOUS BRITISH SNAKE

**The Adder**

*Photograph by Stanley Crook*



THEIR "S O S"

A group of young Magpies

*Photograph by P. Webster*

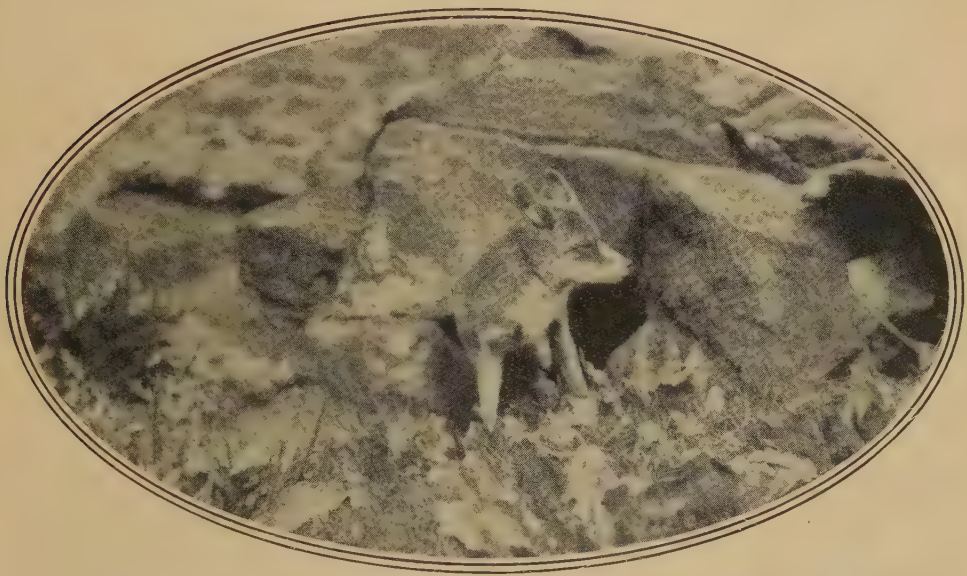


*Photo: Riley Fortune, F.Z.S.*

Unlike his relation the wolf, the Fox does not "pack." Except during the breeding season he lives a solitary life, hunting and killing anything that is eatable.

## 2.—THE LITTLE RED ROVER

By "OBSERVER"

THE fox to-day can hardly be looked upon as an animal in its natural state. Everywhere it has come under man's influence and control—in some parts preserved, in others exterminated, and in many places "turned down" miles from its original home. Besides this interchange of foxes between one district and another, numbers have been introduced from abroad, and subsequent inter-breeding with the home stock has resulted in the shy, fleet-footed, red-coated beast that we see to-day slinking by copse or hedgerow.

Unlike his relation the wolf, the fox does not "pack." Except during the breeding season he lives a solitary life, hunting and killing anything that is eatable. Rabbits are his main source of food, but his diet is extremely varied. Birds of all kinds, both wild and tame, fall victims to his hunger, and hares, rats, mice, voles, frogs, fish, fruit, vegetables, and even insect grubs, are eaten with relish.

Up on the hills, in wild, waste places, lives a larger, darker variety—the hill fox. He lives a hardier life than his brother of the plain, depending for his food mainly on ptarmigan, although at times he varies this diet with the carcasses of hares, sheep, deer and occasionally—but rarely—lambs.

The damage done to lambs is really a negligible quantity, yet it has made shepherds inveterate enemies of foxes. A weakly lamb is very easy prey, and it takes man all his cunning to outwit that of the fox. Gamekeepers and poultry-farmers also have every reason to dislike them. On the game preserves, although the foxes live

mainly on rabbits, yet as they prowl about on the hungry spring nights, they drive many a bird from its nest. Scenting the sitting pheasant the fox suddenly "freezes"—judges the moment and the distance—then springs. If he misses and the pheasant is fortunate enough to flutter away, she may escape, but will never return to the nest, and the eggs are chilled. In this way roosts on the ground, much to the advantage of her enemy.

When hunting, the fox at first works like a setter, running round and round until he gets the scent. He then stops and points, working his way slowly in the right direction. Having located his prey he gathers himself together for a spring. Every muscle becomes taut, and he hurls himself on his victim,

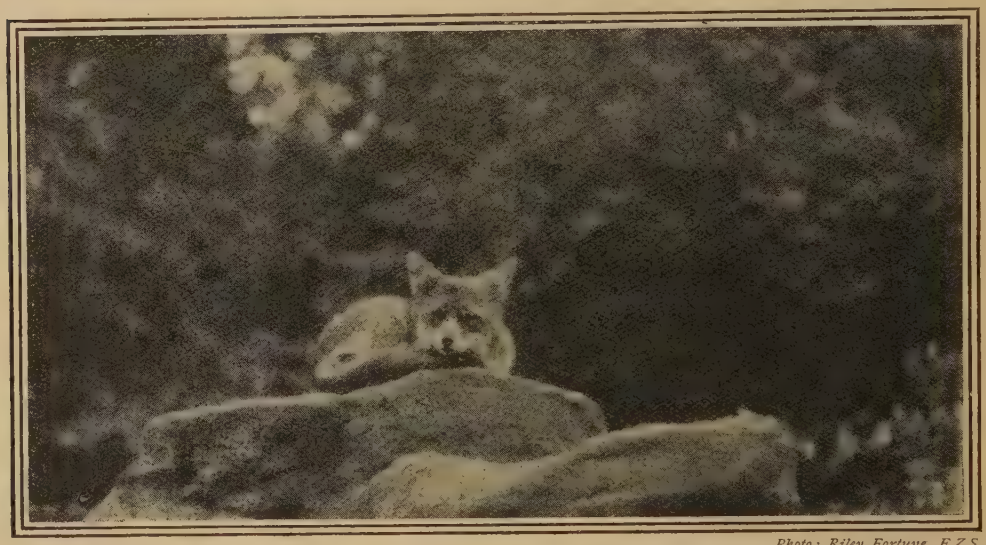


*Photo: Riley Fortune, F.Z.S.*

When hunting, the Fox shows great skill in taking cover and manœuvring the best position for attack.

much damage is done during the nesting season.

Clever though the fox is, he is yet easily destroyed, for the strong smell, the huge hole, his well-known habits, all betray him to his enemy, the keeper. Hence the reason why in some game preserving counties foxes are never to be found, yet only a short distance away the hounds meet and find their quarry without difficulty.

In one fox-earth in Scotland twenty pairs of grouse, two lambs, and several rabbits and hares were discovered; and when the fox lives on a poultry diet his larder is equally full of good things. Some, indeed, assert that the fox is very particular as to his food, always choosing the very best in the way of fowl. Certainly he steals the fattest of the old hens, possibly because the poor thing, being fat, is less nervous and more easily taken, or being too clumsy to get far up the trees, sleeps on lower branches, or seizing it in his mouth, and using his paws to drag it out. If successful, he gallops off and buries it in a quickly made grave, covering it with soil ploughed up by his nose.

Foxes also capture rabbits and poultry by taking advantage of their curiosity. The wiles of the fox are not merely fabulous. Rolling over and over and round and round, his brush in his teeth, he bewilders the foolish rabbits who sit up to watch his antics, while the hens stand by with their heads up, delighted spectators of the comic performance. Then the fox rolls over once more, this time within reach of the unsuspecting victims. There is a sudden leap, a mad tumult of flying feathers or bolting rabbits, and from the centre of the scrimmage the fox issues triumphantly, something mangled and forlorn hanging from his mouth. Again a hole is hurriedly scratched, the victim shoved in, earth nosed

*Photo: Frances Pitt.*

**THE FOX AT CLOSE RANGE.**

Although not at all certain as to what is to be done, his characteristics of cunning and sagacity are strongly suggested.

over it, and a feast is ready for another day.

For all her ferocity, a vixen with cubs is an intelligent and devoted mother ; and as the hunting instincts of her young develop, she becomes obsessed with the thought of their needs and spends all her time hunting for them. The youngsters are born about the end of March, usually from three to six in a litter. For the first month they live almost entirely on milk. It is towards the end of the month that the vixen goes out to catch rats, and not liking to leave her cubs for long she keeps them mainly on this easily-captured diet. The mother-fox is always on the watch. Day and night every sense is alert for danger, and at the least sign of untoward happenings she will be off with her babies, carrying them in her mouth, one by one, to a safer home.

The youngsters have a happy time, eating, gambolling or sleeping the live-long day. Again and again the mother comes back to them, now with a hare, now with a rabbit or a hen, dropping it in their midst and scarcely waiting for it to be devoured before going off for more. Her quickness is surprising. In a moment it seems she is back once more with another victim.

Sometimes she will lie and rest for a time, watching with evident pleasure the gambols of her cubs as they eat or play with the things she has brought. But her maternal conscience gives her no peace, and after a moment's rest away she goes on another hunt.

*Photo: Frances Pitt.*

The Fox-cub is a sportive care-free creature, but is ever on the alert; a strange sound will rouse its suspicions and drive it helter-skelter to cover.

As playful as human children are young foxes. Anything will make a toy ; a rabbit, crushed and bitten out of shape, or the wing of a hen will do, and like a ball it is tossed about, hurled here and there or thrown up in the air to be caught by any who can. They love, too, to roll on their toys, or to trundle something down a slope and run and scramble after it as it rolls away.

Another popular game is racing. The cubs have definite tracks running from their home to some chosen goal, such as a tree

or a stump, a large stone or rock. But not content with merely dodging round the obstacle, all the while they are leaping sideways, snarling and biting and toppling over, and sometimes playing at leap-frog down the track. Usually the game ends by one taking hold of another's tail, and a free fight results all round.

Like all young things, foxes love a rough and tumble, but often in the middle of their fights they will suddenly remember some plaything. The fight stops, and there is a mad scamper to fetch the toy. Then they proceed to bury it and dig it up again, to scramble for it or hurl it to and fro, amusing themselves vastly in the aimless, happy way of children.

It is in this manner that they play in the sunlight, sportive, care-free creatures, yet pausing every now and then to listen.

Very frequently vixens move their cubs when they are half grown, and by easy stages will take them quite long journeys. The first night's trek may be to a wood a mile or so away, and the cubs will sleep there, hidden in the brushwood. Next night she will lead them farther afield, on to some place where food is more plentiful. At the same time she teaches them to forage, and by September the cubs know enough and are brave enough to look after themselves.

At first the cubs are brown or greyish-brown in colour. This is known as their "puppy" coat, but gradually the colour changes to yellow brown, and by the following spring they have acquired the full colour of the mature animal.

The fox has earned a reputation for cunning and sagacity, which no doubt it deserves. It is clever enough at any rate not to interfere with anything very close to its own home, and has been known to live even in the middle of a rabbit warren or a poultry yard without disturbing the inhabitants.

*Photo: Frances Pitt.*

A Fox stealing through the brushwood will squat and scout the situation from time to time, because of its alert sense of danger.

Should they hear any strange sound they lie quite still and wait till all seems safe again. But should the sound denote the approach of man or dog, they turn and bundle into their hole as fast as they can, vanishing from the surface of the earth.

When hunted a fox knows very well that

*Photo: Riley Fortune, F.Z.S.*

On the look out at the edge of a wood, Reynard's characteristic quality of alertness may sometimes be seen at its best.

the hounds are on its scent and will adopt all kinds of methods to throw them off. They have been known to take to a sheep track, to jump into the middle of a flock of sheep, to run through manure, to take to water and double back, and to run among others of their kind and stir them up. And many a time the hounds are baffled and the fox slips away.

At home he lives at times in an "earth" of his own digging, but more often merely in an enlarged rabbit burrow, situated among the roots of a tree or in the centre of a sand-pit. Where the soil is cold and wet, foxes lie above the ground, hiding themselves in the thick hedges, or making a home in a hollow tree. On the mountains they take shelter among the rocks, but hide also in heather and gorse, returning to these spots after each excursion.

As we have already seen, there is nothing more destructive than a vixen with young, since she will kill not only to satisfy the needs of her family, but also for the sheer

*Photo: Riley Fortune, F.Z.S.*

At the least sound of alarm Reynard will display his proverbial wariness by retiring in this slinking, crouching fashion to the safety of the thicket.

love of it. Stories are told of vixens which, having got into a poultry run, have systematically killed every hen. That done, they have left the poultry yards without troubling to carry off a single bird.

In olden days Pliny advised poultry farmers to feed their birds occasionally with the liver of a fox mixed in their food, because, as he said, a fox will not eat flesh carrying its own taint. He also recommended that the cockerels in the poultry yard should wear fox-skin collars, since, he says, the fox is too much of a gallant to touch hens under such noble patronage!

Whether Pliny was right or wrong we leave the reader to decide. Nevertheless, if there be a vixen with cubs in his neighbourhood, we advise him to make his hens secure at night, even if he adopts the further precaution of feeding his birds with fox's liver or of putting a fox-skin collar round the necks of his roosters.

*Photo: R. Kearton, F.Z.S.*

The Fox's reputation for cunning is no doubt well deserved. It is clever enough at any rate not to interfere with anything very close to its own home, and its hunting-range is therefore an extensive one.

# 3.—WHY THE LONG-EARED BAT HAS HUGE EARS

By JOHN J. WARD, F.E.S.

Illustrated with photographs by the Author

JUST what induced this quaint little animal of the long ears to be abroad in full glare of the late afternoon sunlight on a day in mid-May was difficult to understand. In any case, it was a risky procedure, for really it was not due to appear until quite late at night, when all was dark and still; for, unlike some of its relatives, this particular bat species favours the late hours of the night rather than the twilight of evening and morning.

The Long-eared Bat travels over the rough bark of a tree by means of its thumb-claws and tail. Its tiny face is entirely hidden by its huge ears in this position.

The danger of its adventure lay in the fact that it was likely at any moment to be mobbed by a crowd of sparrows and other small birds; for, whenever a creature of the night appears in the light of the day, it seems to incite its daylight compeers to guy it—just as a grotesque-looking person does a crowd of small boys. Should the owl appear before the dusk of evening, it is apt to meet with the same hostile reception.

Probably, owing to the few previous evenings having been cold and frosty, with a consequent scarcity of its insect prey, the voracious little creature had gone to bed hungry for a night or two, and, rather than risk another supperless night, it was driven to this desperate move in order to make sure of such quarry that might be disporting itself in the warm rays of the afternoon sun.

So there it was darting about with astonishing speed on its noiseless organs of flight, snapping at every gnat, midge-fly, moth, or tiny beetle that crossed its path—or rather, whose path it crossed.

In flight it presented a curious appearance. Its huge, expanded ears continually twitching and shaking, together with its strange form and vacillating movement made it a striking and conspicuous object against the sky, and it at once prompted the query: Why does this little bat need such huge ears?

That is a most interesting story.

First we should note that comparative anatomists place the bats very high in the scale of living things, and the old idea of a flying mouse may be at once disposed of.

This little fellow of the long ears is one of the aristocrats of the animal kingdom, a mammal which has attained mastery of the air. Like other mammals, it possesses but two pairs of limbs, and, necessarily, if it is to fly at all, those limbs must be used as flying organs. So it came about that its hands evolved into wings, its finger-bones becoming longer and longer, and the skin membrane between them extending more and more, until a wing-like organ was produced. These enlarged hands are assisted by a

The Long-eared Bat alights and suspends itself in the characteristic head-downwards position.

Underside view as it comes to rest. First it tucks away beneath its wing one of its huge sensitive ears.

further skin extension stretching from its little fingers down the sides of its body, and in-

volving its hind pair of limbs and tail, so that a large web-like area is extended to

Then the other ear is tucked away. The thumb-hooks are plainly visible here.

Finally it wraps its wings tightly round its body and ears, and is ready for sleep.

Throughout the cold weather the Long-eared Bat remains in some sheltered situation sleeping soundly with its ears folded away.

the atmosphere with each spread of arm. It is, therefore, correct to say that the flight of a bat is effected by movements of its hands and arms.

It should be noted that the thumb remains short, as a sharp hook, and it is by means of this organ, and a little leverage from the tail, that the bat is enabled to scramble from its nest, or over the rough bark of a tree to some suitable prominence, to push out into space. Its awkward method of locomotion is shown in my first photograph.

So much, then, for its limb anatomy; but what about the huge ears, proportionately larger than those of any other animal? It has been suggested that these possess an extremely delicate sense of touch, and can *feel* approaching objects in the air, which the bat then avoids in its rapid flight. Since, however, many of its relatives with quite insignificant ears possess this same curious sense—even, as experiments have shown, when their eyes have been covered, and when totally blind, they could avoid interlacing cords and other objects placed in their way, and find their way back to their dwelling-holes—it is more probable, I think, that the wings (or hands) are the sense organs in that case; just as we in a more crude manner might feel heat or cold vibrations on approaching very hot or very cold objects by means of our hands, even though blindfolded.

It is often the most obvious point that escapes notice, and the one which seems to have been overlooked is that ears are to hear with. Why, then, does this little bat require to hear so much that it should need such huge ears? I have previously mentioned that it does not usually fly until late at night when all is still, and when most other bat species have retired to rest. Ages ago, then, when the bat family commenced to evolve their specific differences, our present study became an ear specialist, and developed its auditory organs to a finer and a more

When resting between its predatory expeditions, the Long-eared Bat does not put its ears away. Note how it is steadying itself by one of its thumb-claws.

acute perfection. The whole secret is that these huge ears are associated with its feeding habits—its prey.

When a gramophone record is made, the singer, or instrumentalist, sings or plays into a huge horn, which concentrates the volume of sound waves into the tiny grooves of the record. Our little fellow of the long ears, in the course of his evolution, struck the huge horn idea to concentrate small sound waves ages before man existed : truly there is no new thing under the sun.

All the evidence goes to show that it preys upon silent-flying insects of the late night, such as midge-flies, gnats, mosquitoes, and some moths. Let us, then, consider the evidence.

First there is the late flight, for everybody will have noticed that, apart from wind, the later the night becomes the more silent it is. In the still atmosphere, by means of its huge ears, this bat is enabled to track down by sound its distant prey, and so intercept its flight. Probably the delicate movements of the wing of a gnat set up sufficient sound vibrations to be audible to those great ears at a considerable distance away ; while the flying of a large and powerful moth may sound to it like the throbbing of an aeroplane engine would to us.

How acute its sense of hearing is may be instanced by its own tiny, shrill voice, commencing at a range of sound just about where our sense of hearing gives out. Even some musicians quite fail to hear its high-pitched notes. I have myself heard it call on several occasions when photographing it, and, one day, I found that a seven-year-old boy who stood by my side could hear it at times when I could not. Probably the more acute hearing of the child was able to detect still finer notes that were inaudible to me.

With this small voice, a very razor's edge of sound, it calls to its mate from afar. Since, probably, that is amongst the greatest sounds its sense of hearing is attuned to, we may reasonably assume that its range of notes will go many octaves higher and encompass those finer vibrations entirely inaudible to our ears.

There is still more striking evidence that my suggestion is correct, for when the bat goes to rest it folds up its huge ears and packs them away beneath its wings. Surely no action could offer more definite and conclusive evidence that its ears are associated with its hours of seeking prey. It can hear all it need do when resting, without exposing to danger those delicate organs on which its very existence depends.

We may contend, then, that the ears of this little animal point to an advanced and specialized evolution while adapting itself to habits somewhat different from other species of its race which have retained small ears.

It is difficult to get a glimpse of the Long-eared Bat's tiny face at any time, but here it is seen full front.

Likewise, throughout the winter months, when no food is available, it rests suspended by its hind-feet and tail, head downwards, with its long ears stored away beneath the folds of its wings, for then there is no occasion for their use. The same warm temperature that rouses insect life to action awakens the slumbering bat, and, after a few consecutive warm days, it is one of the first of the winter sleepers to be abroad. Though flying insects are few and far between at such times, yet the sounds from their movement are sufficient to guide their long-eared enemy unerringly on their track.

*Photo: E. Step, F.L.S.*

At no time of the year is the Oakwood so rich in brilliant flowers as in spring, when the leaf-buds are expanding and the light rays are not seriously impeded.

# 2.—SPRING FLOWERS OF THE OAKWOOD

By EDWARD STEP, F.L.S.

OUR oakwood runs for several miles along a ridge of London clay, but little of the clay can be seen except where the wheels of a timber wain have cut through the surface soil and somewhat deeply into the subsoil. The wood is part of the primitive forest that once covered all the clays and loams, and the leaf-fall of ages has piled up a deep layer of humus in which grow many plants whose roots could not penetrate the clay. There are but few ancient trees left, and most of these were pollarded in their prime or earlier —the unmaimed trunks disappeared doubtless during the great period of our wooden navy. The remainder show that the oaks here were never grown in canopy, but were managed more on the old statutory plan of "twelve standels to the acre," a system which allowed every oak to develop its natural form without crowding its neighbours. Between was coppice which afforded plenty of material for coaling, fencing and the like.

To-day our wood is degenerate: an example of that scandalous neglect of natural

SPRING'S AWAKENING

*From a Painting by Arthur J. Black, R O.I.*

resources which has obtained in this country for centuries past. It had set in before John Evelyn's day, for as far back as 1662 he repeated a prophecy that has been verified sharply in our own time. He wrote in his *Sylva :* " The want of timber, and the necessity of being supply'd by foreign countries, if not prevented by better and more industrious instruments, may prove in a short time a greater mischief to the publick than the diminution of coin. I wish I prove no prophet, whilst I cannot for my life but often think of what the learned Melanchthon . . . was wont to say (long before these barbarous wars had made these devastations in Germany), that the time was coming when the want of three things would be the ruin of Europe, *lignum, probam monetum, probos amicos ;* timber, good money, and sincere friends : How far we see this prediction already verify'd, let others judge."

This wood is one of hundreds where the proper custodian, the woodman, has been ousted by the gamekeeper. But the flower-lover, as such and not as citizen, has no reason to find fault with the arrangement, for the open character of the wood allows sufficient light for an abundant and varied ground vegetation, and the undergrowth is left undisturbed in order to provide shelter and harbours of insect food for " the birds." At no time of the year is the wood so rich in brilliant flowers as in spring, when the leaf-buds are expanding and the light rays are not seriously impeded in reaching the ground.

Before the spring really begins, the pliant rods of hazel (*Corylus avellana*) that have been hung all through the winter with clusters of hard grey cylinders, suddenly lengthen and soften these, and colour them yellow with the liberated stamens and pollen ; for the catkins consist of male flowers only. Next, usually amid the blustering of the wild March winds, the stiletto-armed and awkward branches of the blackthorn (*Prunus spinosa*) burst into a wonderful display of snowy blossoms whose opaque whiteness was intensified by proximity to the tangle of black branches. Along the edges of the rides a few precocious plants of the lesser celandine (*Ranunculus ficaria*) have spread out their golden stars above the open rosette of shiny heart-shaped leaves ; and there will now be more of them every day until they reach their maximum in mid-April.

It is to be noted that all those plants that produce their flowers so lavishly in spring are perennials. Such opulent pageantry is only possible as the result of previous industry and thrift. The perennials and biennials that were hard at work last year stored all their surplus products in fat root-stocks, bulbs or tubers underground, where they were secure all through the winter ; the plants are now in a position

*Photo : Henry Irving.*

Before the spring really begins, the Hazel Catkins that have hung all the winter as hard grey cylinders suddenly lengthen and soften and become yellow with the liberated stamens and pollen ; they consist of male flowers only.

to indulge in a gala without counting the cost. Our moralists have missed this point, though they have worked a few nature facts threadbare—sometimes laying hold of them by the wrong ear.

If one digs carefully around one of these lesser celandines and raises it from the ground one will see partly how its thrift is practised. During, and a little after, the later period of its flowering the leaves enlarge and work vigorously to make new material, which is carried down through the leaf-stalks to the base, where it is packed into club-shaped bags, suggesting the long stockings of the hoarders of gold. At this moment these wealth bags are being emptied to defray the cost of this golden display. All the other perennials have treasuries of similar purpose, though they do not all take the same shape; and it is well to add to our knowledge of flower and leaf the characters of these hibernating portions of the plant, for it helps us greatly to an insight into what is called the bionomics of the plant—which we may call in plain language its manner of getting a living.

*Photo: E. Step, F.L.S.*

The Lesser Celandine is a thrifty plant. At the end of its flowering period it stores up reserves of nourishment in club-shaped tubers at its roots. Next spring this hoard is drawn upon to defray the cost of its golden display.

Near the end of March, from under the matted dead leaves, suddenly appeared the wood anemone (*Anemone nemorosa*). The slender scapes each ended in a flower-bud, at first hidden within a three-parted leaf-like wrapper. As the wrapper fell apart the footstalk of the drooping bud lengthened and the bud was seen to be prettily tinted pink or purple. When it opened the inner surface was white; also there were no petals, the sepals being enlarged and coloured to serve instead. The true leaf is divided into three leaflets, which are cut into lobes much like the green bud wrapper; it springs direct from the underground rootstock, but at a little distance from the flower-scape. There are no distinct nectar glands, but a sweet fluid is said to be secreted by the base of the flower. A faint perfume attracts various spring insects, and some of these are able to feast upon pollen and carry much of it away to cross-pollinate neighbouring anemones. If one of the leaf-stalks or flower-stems be traced downwards, there will be found running horizontally, a little below the surface of the soil, the anemone's perennial portion—a hard blackish rootstock. Into that receptacle all that is worth saving from the green stems and leaves will be withdrawn when the anemone's activity is stopped by the rapid growth of taller herbs or the leafing of the copse-wood cutting off the supply of light.

The gem of the oakwood is the wood sorrel (*Oxalis acetosella*), a delicate little plant consisting of scaly crimson threads that run among and over the leaf-mould and hide themselves by sending up long-stalked tender trefoils like clover-leaves, but more

or less hairy. In spring they are yellowish-green above and purplish beneath. The last is a trick to arrest the outward passage of heat rays that have entered the leaf from above, and whose retention is desirable. The thin white flowers, whose petals are marked with fine purple hair-lines, spring directly from the procumbent stem and have stalks even longer than those of the leaves. Before the buds open fully they droop by the curving of their stalks, and in this stage present a close resemblance to the flowers of the snowdrop. When open they face the horizon like the anemone, so that in the case of wind they swing round and turn their backs to it. In wet weather, and at night, they droop and close partially, and the leaflets also fold down against the stalk.

Photo: E. Step. F.L.S.

In spring the delicate little Wood Sorrel, with its yellowish-green trefoils and thin white flowers displaying purple hair-lined petals, is the gem of the Oakwood.

The wood sorrel has two kinds of flowers, but in spring only these graceful white ones, which are evidently intended to secure occasional cross-fertilization by attracting insects, for the pollen is shed before the stigmas are ready to receive it. It remains open for visitors from 9 a.m. until 6 p.m., but as a matter of fact, in this country very few insects have been noted as patronizing it. To overcome the consequences of this neglect the plant later on produces a fresh crop of flower-buds hidden at the base of the leaf-stalks. These have no proper petals, and they remain closed. Their seed-eggs are fertilized by the pollen of the same flower. The capsule remains concealed until the seeds are ripe, when it is elevated on its long stalk well above the leaves. The capsule is divided into five compartments, each division holds two or three seeds separately wrapped in a white elastic coat, and has a slit in its outer wall. If, when the seeds are ripe, the fruit-stalk is touched, the seeds will be shot out violently in succession, some of them striking the face of the searcher after knowledge. The white jacket has turned inside out suddenly, ejecting the ribbed red seed. Some of the seeds may be found resting on the leaves, but most have been thrown to a greater distance.

An earlier flower that is still in evidence is the so-called barren strawberry (*Potentilla sterilis*), whose flowers and leaves present a similarity to those of the wild

strawberry (*Fragaria vesca*), though the likeness fails on a close comparison of the two plants. The "barren" plant is no less fertile than the other, though its fruit is not juicy and edible; its white petals are narrowed and show the green sepals in between; and it has no runners. There are other differences, but those mentioned will serve for discrimination at a glance.

*Photo: E. Step, F.L.S.*

Flowers and leaves of the so-called Barren Strawberry only superficially resemble those of the Wild Strawberry. The "barren" plant is no less fertile than the other, though its fruit is not juicy and edible.

There are plenty of the wood violets with their abundant blossoms; but two species are confused under this popular name: the pale wood violet (*Viola sylvestris*) with smaller, more decidedly lilac-coloured flowers, and the dark wood violet (*Viola riviniana*) with larger slaty-blue flowers. The latter is a little later in its first appearance, but continues more or less throughout the summer, and occasionally prompts the writing of letters to the press recording the "phenomenal" appearance of violets in autumn.

When the sun is shining, our attention is distracted from the ground vegetation at intervals by the loud musical hum proceeding from a sallow bush (*Salix caprea*), which attracts all the bees that are awake; there is nectar to suck and abundant pollen to fill the store baskets. The unopened silky, silver-grey "palm" does not move them, but the green female catkins all spiky with their numerous pistils do; also the males when the released stamens have invested them with golden haloes. At night many moths in hibernation are tempted to partake of the abundant nectar.

A hollow slope on the south of the wood acts as a surface drain of super-abundant moisture, and becomes a languid tributary to the brook in the valley below. The water is hidden by a blaze of shining gold—the large and crowded king-cups of the marsh marigold (*Caltha palustris*). All the winter the thick, creeping rootstocks have lain hidden, but the spring impulse roused them into early activity, and they have already made new growth, spread out their bold, kidney-shaped leaves, and are holding up their brilliant king-cups or "Mary-buds." This is another case of a flower without petals, the sepals being enlarged and coloured to serve instead. It is of interest to compare the marsh marigold with the related lesser celandine, which has somewhat similar though much smaller leaves. There the sepals are green, the petals present, but owing to their narrowness failing to produce the cup-shape of the other buttercups and of this king-cup.

About the bases of young hazel stems, and where they can get early support from the grass or dog's mercury, the brittle-jointed stems of the greater stitchwort (*Stellaria holostea*) are climbing, brightening

*Photo: Henry Irving.*

**BLUEBELLS.**

The Bluebell shares the social instinct of the Primrose and Anemone, and is notable for the broad effects of its colouring, massed continuously over acres of woodland.

*Photo: E. Step, F.L.S.*

The Pale Wood Violet is sometimes confused with the dark species, but it can always be distinguished by its smaller and more decidedly lilac-coloured flowers.

the spaces with their loosely clustered, beautiful white flowers. There is none of the usual machinery of the climbing plant, neither tendrils nor the power of twining, yet it climbs. It accomplishes its ambition by supporting its pairs of stiff, grass-like leaves on anything that comes handy, and holds up its newest section of stem until this has been able to arrange its pair of leaves in a similar fashion, and then pushes up a further length. This stitchwort or satin-flower, though as plentiful as it is beautiful, does not appear to be much sought for by the cullers of wild nosegays. The probable reason for its escape is that in its season there are more showy flowers to be had, for it is the time of the primrose and bluebell profusion in the wood and of cowslips in the fields.

Along the banks and rides the primrose (*Primula vulgaris*) for the time being covers all the available space, its shuttle-cock shaped leaf baskets overflowing with the delicately perfumed pale yellow flowers on long, hairy, pink stalks. As everybody knows, there are two forms of flowers, "pin-eyed" and "thrum-eyed," in other words, with long or short pistils, whose object is to secure cross-pollination. This is a fact that has been long familiar to the general public; but what are the agents by which the interchange of pollen is mainly effected is a question that still awaits a precise answer. A few butterflies, bees, beetles and a long-tongued fly have been observed sucking the flowers, but their visits do not account sufficiently for the vast numbers of seeds produced. The pale tint of the flowers leaves little doubt that their

*Photo: E. Step, F.L.S.*

Climbing without tendrils or the power of twining, the Greater Stitchwort supports its stiff leaves fortuitously, and advantageously displays its loosely clustered white flowers.

more important visitors are night-flying moths; but the matter yet remains open for investigation.

The bluebell (*Scilla non-scripta*) shares the social instinct of the primrose and anemone. Individually beautiful, it is chiefly notable for the broad effects of its colouring, massed continuously over acres of woodland. For a great part of the year it lives out of sight as a little bulb, hidden deeply in the ground below the layer of humus. Its production of strap-shaped leaves a foot and a half long, a tall stem of purple-blue flowers, and fat capsules of ripe black seeds is all compressed into the period before the light is shut out by thick foliage or the canopy of broad bracken fronds. The flowers are produced at the expense of the bulb, for when the buds appear little more than the tips of the leaves are visible, but these lengthen rapidly and work for the perfecting of the seeds and the replenishing of the bulb.

Before the bluebells are half through their blooming, the crooked boughs of the crab-apple (*Pyrus malus*) break out into delightful clusters of pink and white fragrant flowers. There are many other spring flowers in our oakwood that we have not mentioned; we have named only such as from their abundance are most certain to catch the eye. In some favoured woods may still be found hosts of the nodding trumpets of the wild daffodil (*Narcissus pseudonarcissus*); in many south of the Scottish border there is the wood spurge (*Euphorbia amygdaloides*), with its red stems and the bronzed leaves of last year, and its new leaves almost as yellow as its flowers; in most districts the wild strawberry (*Fragaria vesca*), with its neat white flowers, and a host of others

*Photo: E. Step, F.L.S.*

The large and crowded king-cups or "Mary-buds" of the Marsh Marigold hide the water by their blaze of shining gold.

*Photo: S. Crook.*

Young male Adders which have just cast their skin show the characteristic Adder pattern most conspicuously, and are very splendid objects.

# 1.—THE ONLY BRITISH POISONOUS SNAKE: THE ADDER OR VIPER

By P. CHALMERS MITCHELL, D.Sc., F.R.S., etc.

THE adder or viper is the only poisonous reptile native to Great Britain. It is very easy to tell how to distinguish an adder after it has been killed, when the teeth and scales and markings can be examined closely. But even those who wish to be field naturalists dislike taking chances with living snakes, and everyone wants to know of danger in time. Let us begin with the worst. If you are bitten by a creature looking like a snake, it is almost certainly an adder. It is possible that a harmless grass snake, if you were actually handling it, might bite, although I have handled many, sometimes even feeding them forcibly, but have never seen any attempt to bite. They will hiss, make a great demonstration, and even strike at you with their heads when you are trying to handle them or have cornered them in the grass. But they do not bite human beings. If you do get a sharp and painful bite from a British reptile that you have disturbed you may be sure that the enemy was an adder, with a possible exception, presently to be described. The bite is usually on the ankle or hand; if you see two little bleeding punctures from about two-fifths to half an inch apart, there is no doubt. You have been bitten by an adder.

A bad job! But fortunately deaths, even after severe adder bites, are extremely rare in this country, although the venom from the adders in France is more potent. The results, however, are quite often serious, and all precautions should be taken. Suck the wound vigorously, or get someone to suck it for you (the venom does no harm, even though it may be swallowed); open

*Photo: S. Crook.*

**THE ADDER AND THE GRASS OR RING SNAKE.**

The Adder (left) is considerably smaller than the Grass Snake, which often attains a length of twelve feet. The Adder bears on its flattened head the black "V" mark which proclaims its species.

up the punctures with a sharp knife and let the wound bleed freely, holding your arm down if the wound is on the hand, so as to let the blood run; have a strap or handkerchief tied as tightly as possible round the arm or leg above the wound, so as to stop the circulation in the veins as much as possible. If there is permanganate of potash available, rub the purple crystals deep into the wounds. Lie down, keep warm, and wait for the doctor. You will probably have much pain and sickness, and may even become unconscious, and you may be kept in bed for a few days and feel the effects for a week or two.

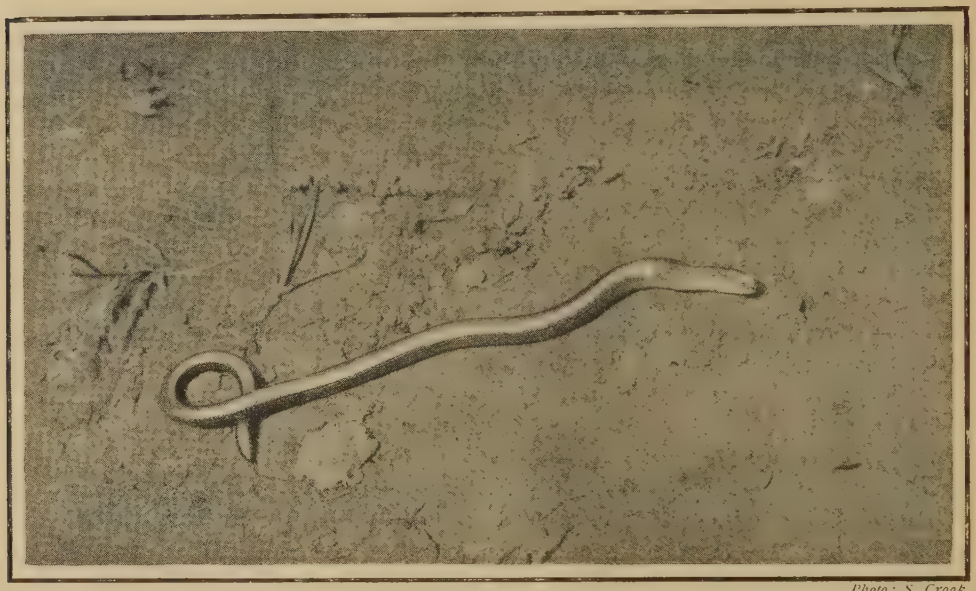


*Photo: S. Crook.*

The Slow-worm or Blind-worm, found all over Great Britain, is really a lizard without visible legs. The smooth metallic sheen of its body is sufficient in itself to distinguish it from the snakes.

And so it is useful to be able to distinguish living adders from creatures which are harmless. In Ireland there is no difficulty, because there are neither adders nor creatures in any way like them. In Great Britain and Wales there are three reptiles which are mistaken for adders, two common and one rare. First there is the slow-worm or blind-worm, really a lizard without visible legs, and therefore snakelike. It is found all over the country, but it is especially common in the western counties of Scotland and England, and in Wales. When full-grown it is from ten to fifteen inches long, but the smooth metallic sheen of the body, looking as if it were clad in polished silver or copper, according to its shade of colour, makes it really quite different from any of the snakes. It differs from adders and other snakes, moreover, in having the eyes extremely bright, although small, and protected by upper and lower eyelids; in the tongue being only cleft at the end instead of divided into two long quivering branches; and in the tail, the region behind the vent, being nearly as long as the body. If you approach a slow-worm with fair caution, it usually remains quite motionless (that is why it is called "slow-worm") and will allow you to pick it up without difficulty, whereas any snake tries to bolt at the slighest sound or quick movement, and if you corner it, will protest by violent hissing and trying to strike at you. Finally, if you do pick up a slow-worm, it will struggle violently, holding its tail stiffly and often breaking it off.

There is some excuse for taking the smooth snake (*Coronella austriaca*) for an adder, but only in one part of the country, because this snake is extremely rare except

in Dorset, Hampshire, Surrey and Berks. If you have the luck to find one, and the slight misfortune to be bitten (there is no venom), you need be in no doubt. An adder strikes sharply and lets go, leaving the pair of punctures as if they had been made by large needles; and the smooth snake bites more slowly and *hangs on*, so that you have to shake it off, leaving a little row, or two little rows, of punctures or bruises very close together. The "viper" which came out of the firewood and fastened on to the hand of shipwrecked St. Paul was probably a smooth snake.

Both the smooth snake and the grass or ring snake will be dealt with at length in another article. The latter is perhaps most often taken for the adder. But here, too, locality is a guide, for it is absent from Scotland, except that it has been very rarely found in one or two of the southern counties; it is rare in the north of England, but common west of a line drawn roughly from the south of Cumberland down towards Middlesex.

Adders hibernate under cut heaps of brushwood, in hollows under fallen wood, in the depths of hedgerows, in masses of withered bracken—anywhere that protection from frost and wet and a soft warm bed can be found, often single, sometimes huddled together. They emerge on sunny days early in the year in the south and

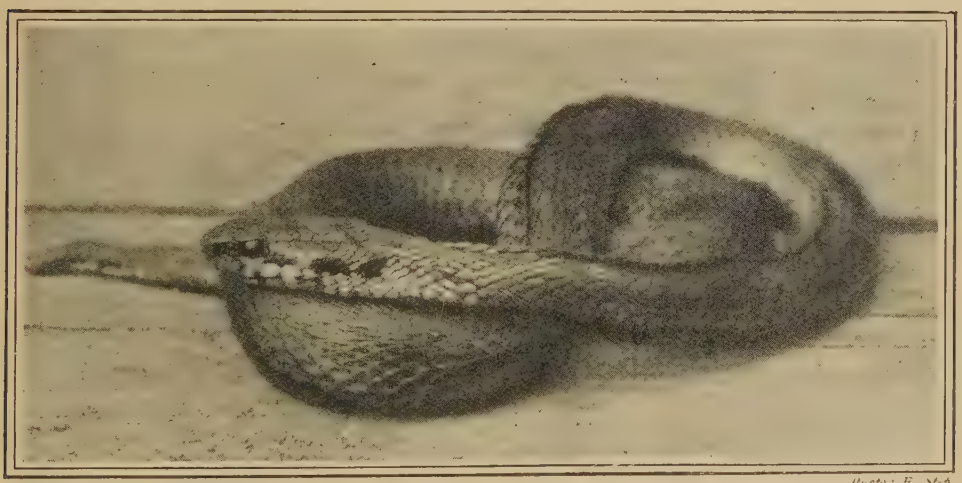


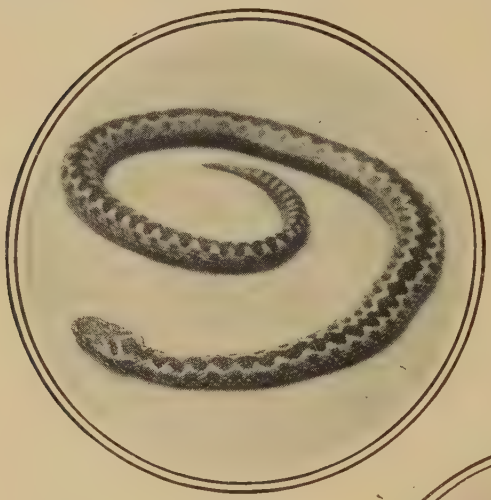
*Photo: E. Step.*

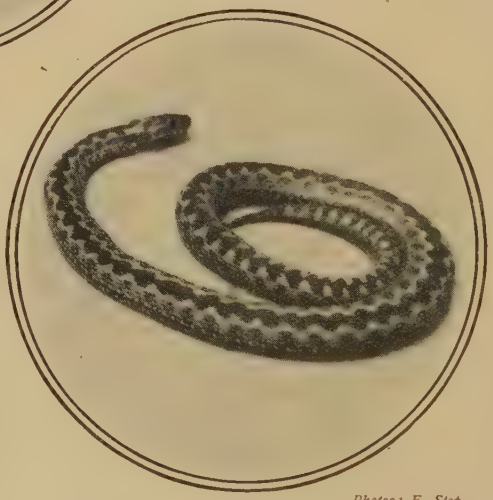
A full-grown Adder averages from eighteen to twenty-five inches in length. The head is broad behind and sharply separated from the neck: the tail is short—some three inches in the male.

Now let us come to adders. They are the most widely distributed British snakes, being found in suitable localities all over Scotland, except in the extreme north but including some of the western islands, in Wales and throughout England. The suitable localities are places protected from bleak winds, with opportunities of basking in the sun and of quickly finding shelter, dry and warm, but not out of range of water. In such places a snake in Scotland, except in the western counties, is almost certainly an adder; in all the eastern counties of England it is more probably an adder; in the west of Scotland, in Wales, and in south-west England it is possible to confuse it with the smooth and lustrous blind-worm; in Wales and in central southern and south-western England there is also the grass snake, and in a very small area (Dorset, Hampshire, Surrey and Berks) there is the additional and only pardonable source of error—the smooth snake.

west, later in colder regions. I have seen one in a Dorset wood in the end of February, and in the New Forest late in March, but there are earlier records. In such early days they are to be seen quite in the open, in full exposure to the sun, and all through the summer the most likely places to

find them are in the open, but near shelter —on a flat shelf of stone in an old quarry, on the edge of a path cut through bracken, on the high bank of a dry ditch. At night they roam more widely and are attracted by fire; those who camp out may often find that adders have crept up close to a bonfire. They are able to swim, and require water for drinking, but their favourite haunts are warm and dry, whereas both slow-worms and grass snakes seem to prefer damp surroundings.





*Photos: F. Step.*

The details of the well-known zigzag pattern of the Adder show to greater advantage on the "white" variety. These two photographs were taken immediately after death.

Adders are heavily built reptiles, weighing more in proportion to their length than slow-worms or grass snakes. The head is broad behind, so that it is sharply separated from the neck; the tail, the region behind the vent, is short, in full-grown snakes being generally about 3 inches in the male and 2½ in the female, although the total length of adult females is greater than that of adult males. The average length of British adders when full grown is from 18 to 25 inches.

In coloration and pattern, adders are usually very conspicuous, except when the skin is dull and in process of sloughing. But both colour and pattern vary much. The ground colour is often yellow to white above, showing off the dark markings; below it varies from deep grey-blue to pale grey. But sometimes the whole ground colour is so dull that the pattern of the markings is hardly visible. Young males just after they have cast their skin show the characteristic adder pattern most conspicuously, and are very splendid objects. On the flattened back of the head there is a black "V" with the point forwardly directed. From this along the middle line of the back is a single row of black lozenges arranged so as to form the well-known zigzag pattern. Towards the tail, the lozenges no longer touch and become narrow transverse bands. Running parallel with this dorsal stripe on each side is a row of round black spots usually placed opposite the angles between the lozenges. It is to be remembered, however, that the pattern is very variable in detail, and in some adders, especially those which are very dark, is hardly visible except on very close examination. Females are less conspicuous than males; the ground colour in them is frequently brownish green to red, with brown marks. There are rather small reddish adders which are sometimes only young females. But they are often specially numerous in a particular locality, and more than one observer has been disposed to believe these small red adders to be a distinct variety.

Adders are very quick and lively, and although they are commonly called deaf, their sense of hearing or of vibration is really very acute. When one is seen sunning itself in

the open, there is no chance of getting near unless the route is so clear that you can creep up without crackling a dry twig or rustling a leaf. I have no natural horror of snakes, and except when I wished to capture one alive, have always allowed them to escape, as they are beautiful living creatures and entirely harmless except when disturbed or attacked. But those who must kill them should aim a blow with a switch or stick behind the head. The backbone is very easily broken, after which, although the body will writhe, the creature is helpless and can be killed by a tap actually on the head. Close examination of a dead adder leaves no doubt as to what it is. Open the mouth, and the two very long slightly curved poison fangs can be seen with their points lying backwards against the roof; they can be pulled forwards into the erect position for striking, with a bent pin. The eyes also should be looked at; they have no eyelids, which distinguishes them from the slow-worm, although like other reptiles they have a transparent, nictitating membrane; the slit of the pupil is vertical, not round as in the smooth snake.

The best way to catch adders without killing them is to have a forked stick with the points of the "V" sharpened and a pair of wooden tongs. If you can creep up to them quietly, which I have often done myself in early spring when they seem inert, but very seldom in full summer, it is not difficult to pin down the neck between the prongs of the stick and then to lift them with the tongs to put them in a well-ventilated tin with some moss or grass. But they do not feed readily in captivity; I have found small lizards to be the food they will take most often, although in the wild state, as may be seen from examination of the contents of their stomachs, they take not only ordinary lizards but small slow-worms, mice, nestlings and eggs, water voles, young rats and even insects and ants' "eggs."

Adders pair early in the year, and the couples usually keep together for months; if one adder is seen, most probably another, its mate, is close to hand. The young, twelve to twenty in number, are produced late in summer, and are very lively little creatures, usually darker in colour than the adults. Apparently they often stay for a time close to the mother, although I never had the fortune to see a family party. And there is the oddest belief, widespread amongst countryfolk and amateur naturalists, that when an adder and her young are disturbed, she will open her mouth, into which they disappear for safety, being disgorged again when the danger is over. There is no scientific evidence for

*Photo: S. Crook.*

In the Adder of the dark variety the flattened head stands out boldly in relation to the smallish neck, but the distinctive pattern is far less obtrusive.

this, and *The Field* newspaper years ago kept an offer of £5 open for anyone who should tie a tape round the neck of an adder that had performed this act of maternal solicitude and bring or send the animal to be dissected by a naturalist to confirm the presence of a family in the gullet. I am happy to repeat the offer on my own account to all readers of this work.

The belief rests on two kinds of statements. Many persons have claimed to have seen the feat being performed. I am sure that they were deceived, possibly by the sudden withdrawal of the forked tongue, less probably by seeing a small slow-worm in the act of being swallowed, more probably by the almost magically quick disappearance of the young into the undergrowth. The other statements are doubtless true; they are, that when an adder has been cut in two by a cartwheel, has had its head blown off by a gun or severed by a stick, that the young have been seen escaping from the wound. But it does not follow that they had been swallowed.

Most reptiles lay large eggs within which the young are already active and lively before hatching. Adders also have large eggs, but these are kept safe within the body of the mother and hatch there. If a female adder with ripe eggs be opened the young may be seen wriggling inside the transparent parchment-like shells lying in the two long egg tubes which extend far forwards in the body. Sometimes young snakes ready to be born can be found loose inside the body. Nothing is more probable than that when a snake ready to produce her young has been cut across, the young have then escaped from the wounded body. The real origin of the swallowing story is this viviparous habit of the adder.

*Photo: J. C. Bristow-Noble.*

The young of the Grass Snake are hatched from eggs laid on the ground; the young of the Adder, on the contrary, are hatched from the eggs inside the parent's body and are born "alive."

# 3.—THE AWAKENING OF THE LEAF BUDS

By G. CLARKE NUTTALL, B.Sc.

With photographs by the Author

IT is only when the first hint of green ripples along the bare branches that "spring's sweet call" is clearly heard. The catkins, swaying in February and March, are too much bound up with wintry skies and nipping winds to bring conviction of awakening Nature, but the pale, tender green of bursting buds has in it a note of joyousness that never fails to be convincing. All winter the dark buds have been resting, yet at the same time, in some mysterious fashion, preparing for the future; but now, urged to action by the sunshine, they begin, each in its own individual way, and each, too, in its own time, to give birth to the baby leaves they have so jealously guarded during their rest.

The elms burst into green life in very early spring, and after their flush of reddish flower become covered with the palest of green rosettes. Some folks say then, "Here come the leaves." But they are previous, for these rosettes are the tiny fruits that are set each in the centre of a pale green wing. Soon the ground beneath the trees is spread with them, as with a carpet, until finally they dry and are hustled away to a destination known only to the March winds. For a short space the trees stand out again, bare and brown—but not for long. Other buds have been swelling and lengthening until they burst with a charm of colour. This is especially apparent in the wych elm. There are chaffy fawn scales without and shell-pink ones within, and these spread apart and allow the exquisite green pleatings to issue and droop, as the photograph shows. The pleatings open into separate leaves (without stalks in the

Leaf buds of the Wych Elm bursting—a beautiful colour-study in palest green, rose pink and chaffy fawn.

wych elm, with stalks in the common elm), leaves that then place themselves in whatever position will best afford them their meed of the sun's rays. An old saying makes the size of the growing leaf the countryman's guide for the sowing of barley—

*" When the elmen leaf is as big as a mouse's ear,*
*Then to sow barley never fear.*
*When the elmen leaf is as big as an ox's eye,*
*Then say I, 'Hie, boys, hie.' "*

This beautiful twig of the Beech is the entire contents of a winter bud (left). The leaves are a brilliant semi-transparent green, and they are edged with silver hairs, which they presently lose.

Somewhat akin are the buds of the beech, though these are larger and more delicately pointed. They shine like burnished copper in the pale spring sunshine, and as the enfolding brown scales give under pressure from within, the fragile young leaves, folded in dainty fan-like pleats, pour out. They are protected from undue heat and moisture by an armour of silver hairs, and at this stage the bursting buds—copper, silver and emerald—are some of the fairest jewels of the spring.

Contrast the bud of the beech with that of the oak. In the oak we have the suggestion of immense strength and endurance rather than of grace, and the stiff, knobly buds carry out the same idea of ruggedness. The embryo leaves are not neatly folded within the leathery outer scales, they are just crumpled up, and as they emerge they bear witness, in their irregular outline, to the untidy conditions under which they are formed. The oak, " monarch of the trees," secure in its magnificence and power, seems to scorn the niceties of smooth line and flowing curves.

The Oak bud—like the tree—is rugged and uncompromising. The leaves are crumpled within it, and emerge in a rather untidy fashion.

How different from the elm, beech and oak are the important-looking buds of the horse chestnut, the handsomest and biggest

buds carried by any of our trees. In early spring they lose their dull surface and shine brilliantly, as their coat of varnish, which has served as a waterproof through the winter, begins to melt under the increasing warmth of the sun. They are wonderfully formed, built up wrap after wrap of protective scales, some seventeen in all, and within these scales, to make protection doubly sure, is a further covering of thick hairs, while in the innermost shrine are two pairs of minute pleated leaves, with, if the bud be a terminal one, an embryo spike of

The Horse Chestnut bud is large and important. Note the many enwrapping scales.

The Ash starts its leaves from a purplish-black bud They are cut up into an uneven number of leaflets.

flowers. When the scales loosen and allow the leaves to appear, each of these latter is seen to consist of seven leaflets, folded in half lengthwise, and its tissue set in tiny fan-like pleats. Eventually, as can be best seen in the picture, the pairs of leaves push right out and arrange themselves crosswise. At first they often droop a little, umbrella-like, but soon they raise themselves and

The Sycamore bud has a deprecating air, but it flushes with beautiful red tints, so that the branches seem studded with coral.

stand covering the tree like a number of green candelabra.

If the chestnut bud has a bold, assertive look about it, the bursting bud of the sycamore gives quite a different impression, one almost of deprecation. Set in pairs, not merely along the branches but, which is unusual, with a pair at the end as well, it is more egg-shaped and less like the head of a bedpost than the bud of the horse chestnut. Still, it too is an important-looking bud, and before it bursts it may have increased to an inch in length. At the same time its dark winter colouring gives place to flushings of pink and red, so that the brown branches are studded as with coral. Between the scales push the coming leaves like two vivid green horns which lengthen and release their pleatings, drooping like pinions, while still two other pleated leaves push between them.

Stages in the development of a Hazel bud. At first the tiny leaves are covered with downy hairs, but these disappear with later growth.

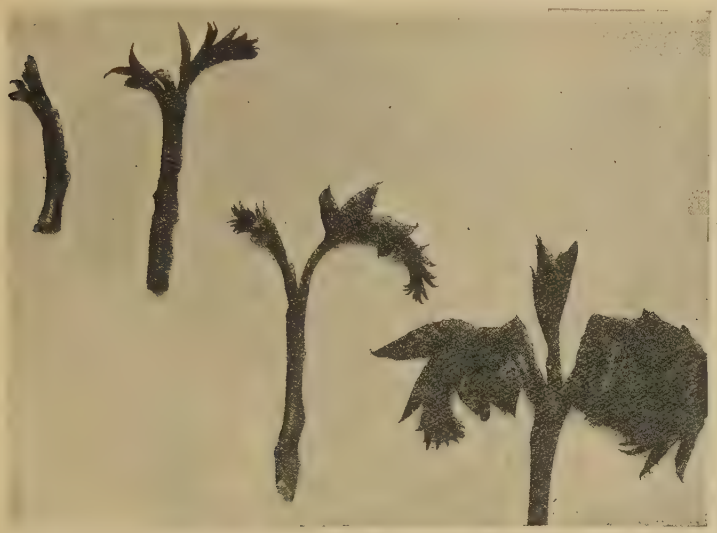
Grim are the buds of the ash. Dark all the winter, but blacker and blacker as the spring draws on, they sit on their stiff brackets in pairs up the grey branches, looking as if they had been dipped in ink. No brilliant hues or jewelled tints greet the sunshine; they seem to be in mourning for the drear winter days that are past rather than dressed to give a welcome to the coming spring. Even when they open it is a dead, dullish-green that presents itself in the many-leafleted leaves When it is spread, however, the leaf is pretty enough, for each is cut up into a number of leaflets, one terminal and the rest set in a varying number of pairs along the mid-rib.

The buds of the Lime are very late in bursting, and they usually burst downwards for the sake of greater protection.

The twigs which carry the bursting hazel buds look often as if a number of green moths had settled thereon. The leaves are roughly pleated and at first covered with soft down, but this disappears as they grow into somewhat coarse leaves with an unexpected sharp point.

Among the lesser trees, too, is the lilac, one of the first to present its leaves

The bud development of the Lilac is on very formal lines. The leaves lie over each other, and are not pleated in any way.



The Walnut's awakening bud is curiously lop-sided. The young leaves are powdered with golden spots—translucent tannin glands.

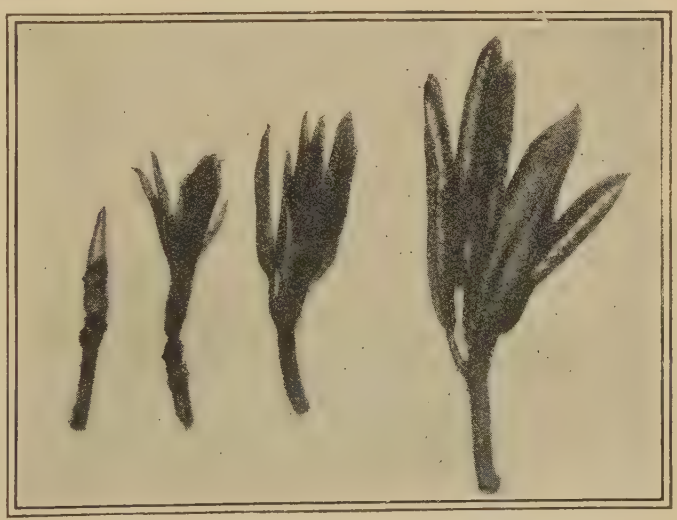
The leaflets are flecked with gold spots—tannin glands—from which arises a sweetish odour, but acrid beneath the sweetness.

The lime even outclasses the walnut as a sluggard. Its leaves, indeed, are usually the last to come and the first to go. When the buds do at length burst, lovely red leaf-structures can be seen within. They burst downwards for the greater protection of the delicate leaves, and often the new leaves hang like rows of hearts along the branches. As they emerge they are folded round the main veins which radiate from the point where the stalk is attached.

to the spring. In full foliage they are rather uninteresting, and in all stages of development, from the tight little bud to the mature twig, there is a curious formality. The leaves are produced in pairs, each pair at right angles to and clasping a younger pair, so there are no attractive pleatings and foldings.

In contrast to the early awakening of the lilacs we have the tardiness of the walnut and the lime which are the sluggards among the trees. The walnut—whose name signifies "a stranger"—has also strange ways, and its developing buds have a distinctly eccentric appearance. The winter ones are stumpy and covered with a couple of dark scales. These open widely and a number of small stalked bundles of different sizes appear. Each proves to be a leaf made up of seven to nine folded leaflets, and as it grows and opens the central stem curves back sharply, and a very curious lop-sided appearance is produced.

The bud of the rhododendron has a completely different way of behaving from all the preceding buds. It contains a number of tiny leaves standing erect, and each rolled lengthwise and backwards in twin rolls. These gradually uncoil, the face of the leaf broadening at the same time.



In the case of the Rhododendron bud the leaves are rolled on their backs—lengthwise—and unroll as they grow.

*Photo: A. Harold Bastin.*

Thayer's famous theory that the presence of an animal may be betrayed to its enemies by sharpness of outline, or the shadow it casts, even though its tints accord perfectly with the background against which it rests. The illustration is from a model which illustrates the principles of "Thayer's Law." (*See pp.* 107-8.)

# 2.—NATURE AS A CAMOUFLAGE ARTIST

By A. HAROLD BASTIN

EVERYONE who has paid any attention to natural history knows that many animals resemble their customary surroundings in colour and form. Among insects, we find numerous and striking instances of this protective resemblance, as it is called. Thus, green caterpillars are often very difficult to find because they match the leaves among which they live. Other caterpillars simulate twigs, not only in colour and shape, but in the stiff, stick-like pose which they assume when they are resting or asleep. There is, too, a whole family of insects, related to our grasshoppers and crickets, and known popularly as "spectres" or "walking-sticks," whose long thin bodies and legs look just like so many twigs or grass-stems loosely jointed together. Most of these insects belong to tropical regions; but a few are found in southern Europe; and one of these, called *Bacillus rossii*, has been much in vogue in recent years with British nature students as a novel "pet." It feeds contentedly on privet, and will thrive and multiply in the temperature of an ordinary living room, even in winter. Indeed, there is little doubt that in certain mild, south-western localities—for example, near the sea-coast in Cornwall—it could be established permanently as an "introduced species." Those who have kept and watched these weird insects need not be told how cunningly they dispose themselves among the twigs of their food-plant, nor how difficult it often is to count up the full complement of one's captives, simply because one fails to detect where the plant ends and the insect begins.

*Photo: A. Harold Bastin.*

The caterpillar of the Brussels-Lace Moth provides a marvellous resemblance to a lichen-covered twig.

Now one is inclined to argue that a resemblance which is sufficiently exact to baulk the keen wits of mankind must also deceive birds and other creatures that prey on the insects concerned — always provided that the latter remain perfectly still. But one must not jump too quickly to conclusions nor forget that many wild creatures can, and do, track down their prey by means of other senses than that of sight; for instance, by smell. Still, the observations of competent naturalists in many parts of the world tend to show that the resemblance of insects, and other much-hunted creatures, to their surroundings is really "protective" and "life-saving." Numerous instances might be cited, of which the following, from the pen of Sir Ray Lankester, is typical, and especially interesting, because this veteran biologist tells us frankly that it is the only case in which he himself has watched the protection afforded by colour at work. "It was on a summer's evening when I saw this little moth zigzagging up and down with the most extraordinarily irregular flight, and a bird pursuing it. Twice the bird swooped and just missed his prey owing to a sudden turn and drop on the part of the moth. And then to my great delight the moth flopped against the stem of a tree on which was growing a greenish grey lichen. The bird swooped again close to the tree, but failed to see the insect, and quitted the chase. It took me an appreciable time to detect the little moth resting against the lichen, and closely matching it in colour."

We may safely assume that some, at least, of the more striking examples of protective resemblance have been long familiar to man; for such creatures as stick-insects and leaf-like butterflies can scarcely have been passed over without remark when our forefathers began to take intelligent cognizance of the world around them; but only in comparatively recent years have we begun to discover what a consummate artist Nature really

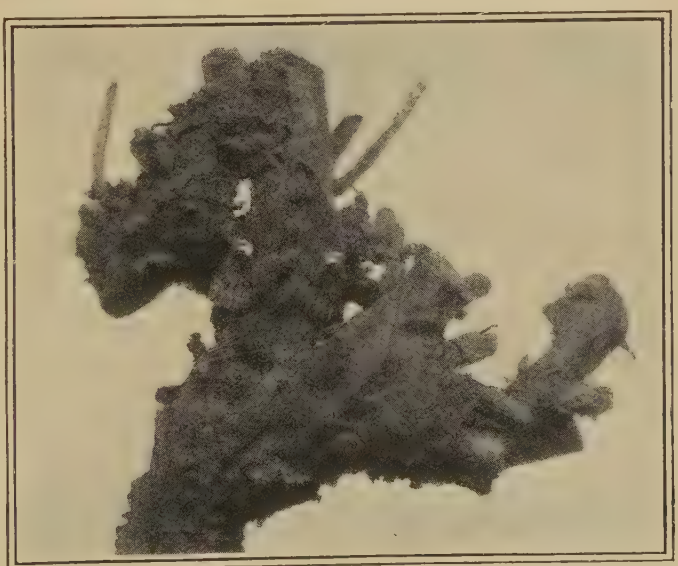


*Photo: A. Harold Bastin.*

Nature's use of the "white spot" may be seen to perfection in this illustration of the Common Dot Moth at rest on a bit of gnarled black currant stem.

*Photo: A. Harold Bastin.*

Swallow-tail Butterfly caterpillars feeding among carrot foliage are difficult to detect. When it is remembered that the gaps between massed foliage, seen in full light, look nearly black, it is easy to realize why this should be.

is. We used to look down upon her as a sort of well-meaning amateur. Now we realize that there is no trick or artifice known to man that she has not practised from time immemorial; and we are beginning to suspect that she can still teach us much concerning the technology and management of "line," "colour," "light and shade," and so on, if only we can and will put ourselves into the proper frame of mind to learn. Indeed, it is now an open secret that the rapid development and successful use of what we called "camouflage" during the Great War, both by land and at sea, were due to a deliberate unifying of science and art; that is to say, naturalists and artists, working together to promote one end, and combining the experience gleaned from their separate fields of research, were able not only to make helpful suggestions, but in many cases to show exactly "how the trick is done."

Although the fact of "protective resemblance" was doubtless familiar to the early naturalists, the strange "oneness" of Nature's methods with those of a human artist was not recognized until much later. Apparently, Professor E. B. Poulton was the first to lay stress upon the important principle of shadow neutralization, or obliterative colouring. This he did when he described the manner in which the "joint" between the stick-like caterpillar and the twig which it grasps with its two hind pairs of "claspers" or pro-legs is made difficult to detect. "The underside of the caterpillar is somewhat flattened, so that it is in contact with a small part of the circumference of the branch, and the furrow on each side is partially filled up, at any rate in certain species, by a number of fleshy tubercles. The shadow which would betray the furrow is also neutralized by *the light colour of the tubercles*." Professor Poulton also emphasized the protective value of appropriate shading in the case of the large green pupa of the purple emperor butterfly, which closely resembles the sallow leaves among which it is suspended. This pupa, or chrysalis, actually measures on the average 8.5 mm. in its thickest part; yet it *looks flat*—like a leaf. "The dorsal side of the pupa forms a very thin sharp ridge for part of its length, but the slope is much more pronounced in

other parts and along the whole ventral side. But exactly in these places, where the obvious thickness would destroy the resemblance to a leaf, the whole effect of the roundness is neutralized by increased lightness, so disposed as just to compensate for the shadow by which alone we judge of the roundness of small objects. The degree of whiteness is produced by the relative abundance of white dots and a fine white marbling of the surface, which is everywhere present mingled with the green. The effect is, in fact, produced by a process exactly analogous to stippling. The degree of lightness produced in this way exactly corresponds to the angle of the slope, which, of course, determines the depth of the shadow. By this beautiful and simple method the pupa appears to be as flat as a leaf, which is only a small fraction of 1 mm. in thickness."

These two observations undoubtedly supply us with the key to a true understanding of Nature's protective colouring. But their significance was scarcely realized until Mr. Abbot H. Thayer, the American artist-naturalist, called attention to the fact (now well recognized) that the presence of an animal may be betrayed to its enemies by the sharpness of its outline, or by the shadow which it casts, even if its tints accord perfectly with the background against which it is seen. He went on to remind us that a human artist, by the process known as "shading"—i.e. painting in of shadow—produces the appearance of relief, or solidity, on his flat canvas. Now Nature—so Mr. Thayer claimed—often aims at producing an exactly opposite effect. Her shading results in what we may speak of as a "painting out of shadows," the result being that the appearance of solidity is *effaced*. To illustrate his theory Mr. Thayer made a model, replicas of which may be seen

*Photo: A. Harold Bastin.*

Two pupæ or chrysalides of the Purple Emperor Moth suspended among sallow leaves, to which they bear an extraordinary resemblance.

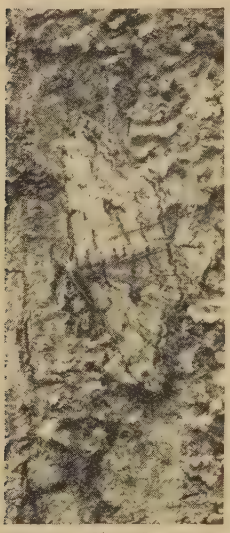


*Photo: Hugh Main.*
The Oak-feeding Moth (*Boarmia roboraria*) is barely distinguishable as it rests on the bark of the tree.

pale below. Briefly, the model is a box with its top and one of its sides removed, in which two dummy birds are fixed. Both the latter are covered with the same grey material with which the box is lined. One is otherwise uncoloured, and is rendered very conspicuous by the illumination of its back, and the heavy shading of its under surface—thus showing that mere identity of colour between an animal and its surroundings does not in itself afford protection, but rather the reverse. The other dummy is skilfully painted with a dark tint above shading through increasing paleness to white beneath, with the result that an effect of flatness and unreality is produced. At a distance of four feet this dummy is practically invisible.

The principle of shadow neutralization or obliterative colouring is now often spoken of as "Thayer's Law." Its recognition has served to indicate new avenues for inquiry, and to add fresh zest to nature study in the open. Many questions are being asked with hopeful insistency which only a few years back would have seemed unanswerable. For instance, we want to know—and we believe that we shall discover—what is the precise optical effect upon each other of two differently coloured areas in juxtaposition; what is the exact significance of certain types of pattern which occur commonly in nature—as, for example, along the margins of butterflies' wings; why many insects, which are startlingly conspicuous close at hand, or in a room, should become to all intents and purposes invisible when looked at from a short distance in their natural environment.

in a number of museums throughout the country. This model supplies us with a very convincing explanation of the fact that many birds, beasts, fishes, insects, etc., are dark above and white or

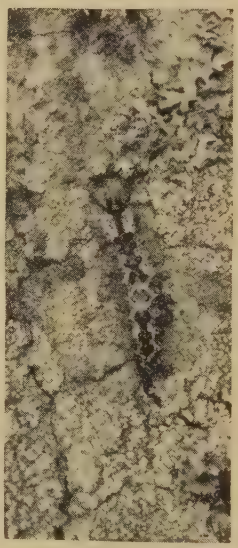


*Photo: Hugh Main.*
The caterpillar of the Black Arches Moth (*Lymantria monacha*) seen upon the bark of an oak.

Already much useful and illuminating work has been done—not a little of it by enthusiastic amateurs. One "spare-time naturalist," Mr. Joseph Neale, of Bournemouth, has paid particular attention to the well-known puss-moth caterpillar in the progressive stages of its growth, and has reared many hundreds of these insects on bushes in his garden. In the earlier stages of its development, this caterpillar feeds chiefly at night, and rests during the

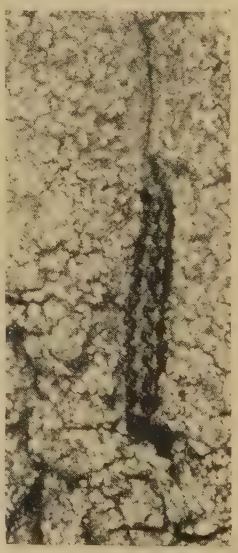


*Photo: Hugh Main.*
The caterpillar of the Merveille du Jour Moth (*Agriopis aprilina*) as seen upon the bark of the oak.

day, in full view, upon the upper surface of a leaf, where—thanks to its dark coloration—it has the appearance of a hole torn or nibbled in

*Photo: Hugh Main.*
The Moth, *Boarmia gemmaria* (*Rhomboidaria*), resting on a rock.

the substance of the leaf. This is because the holes in, and spaces between, leaves—when the foliage is seen in a strong light—*look black*, or nearly so, like the young caterpillar. But if the perforation of the leaf is more than a narrow slit, recently made, we have to consider the somewhat curved and highly lighted margin of the hole, probably bordered with brown, or reddish-brown, where the tissue is dead or dying. According to Mr. Neal, these various appearances are imitated with wonderful fidelity by the puss-moth caterpillar in the intermediate stages of its growth—during the whole time, in fact, when it rests stretched out on the surface of the leaf. In the last stage of its growth, however, before changing to the pupa, the full-grown caterpillar hangs back downward from a petiole or a leaf-edge. It is now too big to pose any longer as a hole in a leaf! But, "when attached to its support at a high angle, and seen laterally as a passing bird might espy it, it presents the appearance of two green leaves against a background of purple bark or shade; while in a horizontal position—which on the average of occurrences in the foliage of a large *Populus* must be the commonest posture—the dorsal saddle is an accurate copy of the slightly upturned tip of a fore-shortened leaf."

In this family (*Notodontidæ*) of the "puss" and "prominent" moths many of the caterpillars are of most curious form, and assume remarkable attitudes when at rest, while the colouring is often very complex. These characters, working together, serve to disguise the insects in a most wonderful way when they are in the open, and among their normal surroundings—although, if we see one of them for the first time in a cardboard box, we shall find it difficult to credit this statement. Some—such as the caterpillars of the "pebble prominent" and the "coxcomb prominent" moths—look exactly like bits of a partially eaten leaf; and they usually rest in contact with a portion of the leaf on which they have been feeding! The resting caterpillar of the lobster moth resembles a dried and crumpled leaf; but when disturbed it assumes a menacing or "terrifying" attitude—and looks like a hobgoblin spider!

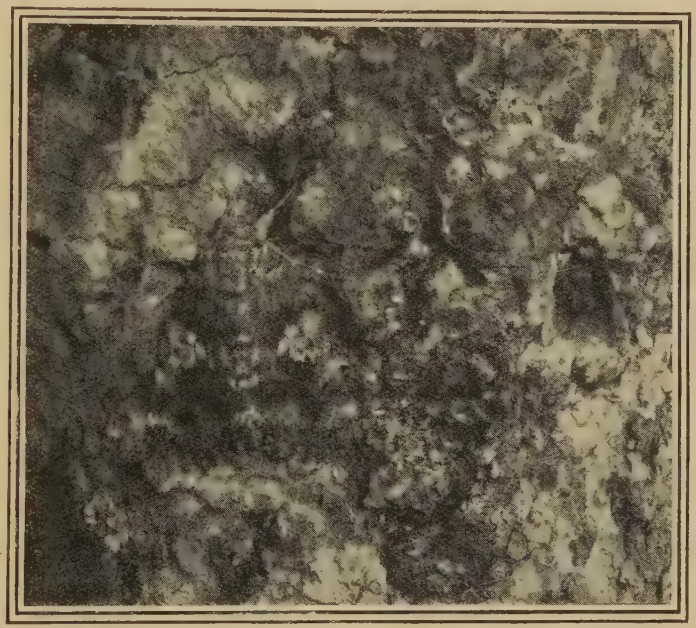


*Photo: A. Harold Bastin.*

A remarkable illustration of the principle of "life-saving by colour" is provided by the Crimson Underwing Moth as seen on the trunk of an oak. The moth is almost invisible!

Other caterpillars (e.g. those of the "Kentish-glory" moth) are so coloured as to resemble the catkins of the trees whose leaves they eat, or the flower-heads and fruit-ears of grasses. Others, again, have their bodies striped longitudinally with dark and light lines in alternation—an artifice which renders them practically invisible when they are among herbage where grasses and other narrow-leaved plants predominate. The colour scheme of the swallow-tailed butterfly's caterpillar, when full grown, may be regarded as an elaboration of the same principle. Here we have bright green, barred and spotted with black, which when seen against a white or pale background renders

the insect very conspicuous, but among the much-divided foliage of its umbelliferous food-plants serves as an almost perfect disguise—exactly as the colour scheme of the zebra causes this animal to "blend" with its normal background of sun-dried grasses on the African velt. It is an interesting fact that caterpillars which are coloured in these ways are not found on trees of the "broad-leaved" sort; while some of those which feed on conifers *have* longitudinal stripes, in correspondence with the needle-like foliage of firs, spruces and larches. In contrast with this, we have the hawk-moth caterpillars, which live on broad-leaved trees and bushes, and have on their sides a row of light, oblique stripes which are disposed to the longitudinal axis of the body at the same angle which the lateral veins of the leaf of their food plant have to its midrib. The anal spine, or "tail," which characterizes the larvæ of this family, also heightens the leaf-like effect by suggesting part of a leaf-stalk or petiole. But it is necessary to emphasize again the fact that these caterpillars do not look in the least leaf-like apart from their food-plants. If we wish to understand the significance and prove the efficacy of their colours as a disguise, we must study them in the open, and in relation to the "general effect" of the surrounding foliage. Then we shall realize how it was that a recognition of some of the "laws" which govern the coloration of caterpillars enabled our Admiralty, during the war, to camouflage merchant-ships into inconspicuousness. Those who know the caterpillars, and have seen examples or photographs of the transformed ships, will not fail to trace the connexion.

*Photo: A. Harold Bastin.*

The Orange-tip Butterfly at rest, showing what is "aimed at" by the curious colour pattern on the underside of its wings.

Many protectively coloured caterpillars habitually adjust themselves in relation to the angle of maximum light intensity—a fact which has not yet received the attention which it deserves. For instance, if we take a caterpillar of the poplar hawk-moth, at rest on a small branch of its food-plant, the stalk of which is inserted into the neck of a bottle containing water, we may place them—insect, branch and bottle—upon a turn-table, and rotate them at will without disturbing the caterpillar's sphinx-like repose. A rough and ready turn-table, suitable for this purpose, may be contrived from two pieces of board and a long, stout wire-nail. Now, whenever the caterpillar on its branch is moved, we shall find that it curves or bends its body, this way or that, as need may be, so as to bring itself into a particular relationship with the window through which the strong light reaches it. This will happen

*Notes on the Illustrations on p. 111.*—1. The chrysalis of the Purple Emperor Butterfly looks like a flat sallow leaf because of its shading; it is really quite a bulky object. 2. The Lappet Moth (*Gastropacha quercifolia*) looks like a bunch of crumpled leaves. 3. The larva of the "Coxcomb Prominent" Moth (*Notodonta camelina*) resembles a partially eaten leaf, beside which it rests in a characteristic attitude. 4. The caterpillar of the Lobster Moth (*Stauropus fagi*) resembles a crumpled leaf. 5. The Buff-tip Moth (*Phalera bucephala*) presents a wonderful example of Nature's colouring, evidently planned to imitate a small bit of rotten twig. 6. The larva of the "Pebble Prominent" (*Notodonta ziczac*) looks like a partially eaten leaf. 7. The larva of the Emerald Moth (*Geometra papilionaria*) resembles a birch catkin. 8. The Marbled Minor Moth (*Miana strigilus*) on oak bark.

EXAMPLES OF LIFE-SAVING BY COLOUR AND FORM.

*The notes to these illustrations are on the opposite page. Nos. 1 and 5 are from photographs by A. Harold Bastin, and Nos. 2, 3, 4, 6, 7 and 8 by Hugh Main.*

*Photo: Hugh Main.*

The larvæ of the Kentish Glory Moth (*Endromis versicolor*) resemble the green catkins of the Birch.

again and again, immediately after the table has been turned, for the caterpillar seems never to tire of adjusting itself. Can we doubt that this remarkable light-responding habit has become fixed, as an " instinct " in the course of the insect's evolution, because the colour scheme upon which its safety largely depends " looks best "—i.e. most leaf-like—when it is brought into a given relationship with the " high light " ? It is practically certain that many insects —e.g. moths whose wings simulate lichen-encrusted bark—instinctively come to rest, when circumstances permit, upon a congruous background. In what manner the choice is guided, and what is the nature of the nervous machinery involved, are points which cannot be discussed here ; but most observers agree that the average of " hits " is far too high to be accounted for on a theory of " happy chances."

Protectively coloured creatures, if their disguise is to prove successful, must know how to keep still ; for no sooner does an apparently dead leaf, bit of stick, or tuft of lichen *begin to creep*, than all hope of prolonging the deception ends. In this connexion it is interesting to note that some insects seem to pass periodically into a state of trance, which continues during the normal resting period—perhaps for many consecutive hours. Experiments conducted on the Continent not long before the outbreak of war show that some, at least, of the *Phasmidæ*, or " stick-insects," are always in a cataleptic state when resting. A species called *Carausius morosus* was the special subject of observation. It feeds at night, and during the hours of daylight rests motionless with extended limbs among the twigs of its food-plant, where its stick-like form and greenish tints render it inconspicuous.

It seems certain that this insect's complete tranquillity, which was once regarded merely

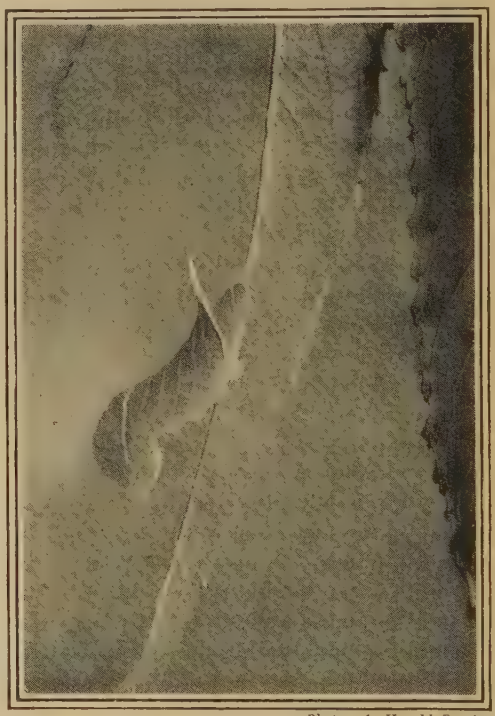


*Photo: A. Harold Bastin.*

A caterpillar of the Poplar Hawk-Moth seen resting in full light against a background of the same colour-value as its own body and that of the willow leaves. Were the leaves more numerous, as they would normally be, the caterpillar would be practically invisible, thanks to its coloration and light-responding instincts.

as the normal accompaniment of slumber, is really due to catalepsy—or to "auto-catalepsy," as it is called, since the condition arises from unknown *inner* causes, and the insect cannot be hypnotized artificially, like rabbits, crayfish, and some other beasts and birds. The muscles of *Carausius*, during its diurnal inactivity, are in the condition which physiologists call *flexibilitas cerea*, or wax-like flexibility; that is to say, they are strained, but not extremely so, and if further stretched they remain in the new position. Moreover, the insect evinces no sign of animation, even when mutilated. Although these astonishing facts have only recently come to light, and have so far been demonstrated in but few instances, they afford strong presumptive evidence that many insects pass periodically into a state of self-induced trance, more or less complete. The whole question calls for investigation, and new facts are likely to be disclosed at no distant date.

Naturalists have remarked that some creatures, when lying motionless in an exposed situation, are not only protected by their own coloration, but derive benefit from the presence of any conspicuous object which may be near them. Indeed, there is reason for thinking that certain animals instinctively make use of this "law of proximity," as we may call it, by coming to rest in a spot where they may hope to profit, for example, by the strong light reflected from a white stone or from the surface of water. In such places the strong white reflection tends, by its very brilliance, to conceal all relatively sombre objects in the immediate vicinity. The eye is dazzled, as we say, by the brightness, which powerfully stimulates the sensitive retina, and (as it were) rivets the attention of the brain, so that neighbouring objects of less luminosity are overlooked. In view of this fact, it is interesting to note that very many "owlet" moths have a conspicuous pale-coloured spot or patch in the centre of each fore-wing. In other respects, the fore-wings—which are

*Photo: A. Harold Bastin.*

The caterpillar of the Pine Beauty Moth displays the protective value of its stripes among the pine "needles" on which it lives.

exposed to view when the insect assumes its characteristic resting pose—are marvels of protective colouring ; and one might be inclined, at first thought, to suppose that the pale spots or patches must detract from the concealing effect. Yet in all probability the reverse is really the case ; for it may be

*Photo: Hugh Main.*

The larva of the Eyed Hawk-Moth (*Smerinthus ocellatus*) shows the row of light, oblique stripes and projection at "tail" to represent part of a leaf-stalk which characterize caterpillars of its family.

shown by actual experiment that, by holding the observer's attention, they prevent him from detecting the tell-tale outline of the insect ; so that he fails to perceive where the real surface of the bark or stone (upon which the moth is resting) ends and where the imitation begins. A knowledge of these and kindred facts gleaned in Nature's fields led to the suggestion, made early in the war, that a number of white objects scattered promiscuously near the trenches in full view of the enemy marksmen would render their shooting no easier, if, indeed, they did not serve seriously to deflect their aim ; while it is possible that when (as was observed) the Germans made use of pure white sandbags for building the parapets of their trenches, they were not acting freakishly, but had a definite end in view, dictated by scientific principles.

We see, therefore, how necessary it is that the stereotyped habits, or "instincts," of an animal should closely correspond with its coloration—if the latter is to prove successful as an aid to concealment. Moreover, there must be no incongruity with physical peculiarities—such as the mode of wing-folding when the insect comes to rest. Thus, we find that protective colouring is confined to those parts of the body and wings which are exposed to view when the insect assumes its normal sleeping or resting posture. Many of our native butterflies including some of the gayest, have the *underside* of the wings so coloured that the resting insect is quite inconspicuous. In the case of the "owlet" moths (*Noctuidæ*), which rest upon tree trunks or rocks, the hind-wings are often conspicuously—even brightly—coloured, but they are completely hidden by the fore-wings, which are folded roof-wise above them when the insect settles. On the other hand, the "carpet" moths (*Geometridæ*), which rest with the wings spread open, have the whole upper wing area protectively coloured. Other striking examples are the buff-tip moth—like a small piece of dry and decaying twig, with its broken ends, all complete, and the lappet-moth—like a few withered and crumpled leaves. The orange-tip butterfly, when resting, resembles a cluster of tiny white flowers (such as those of the cow parsley) as they appear when seen against a luminous green background ; while the little green-hairstreak butterfly seems to become a part of the bramble spray upon which it pitches, because the underside of its folded wings are leaf-green—just the right shade, too, to harmonize exactly with its environment.

These are a few striking examples of Nature's achievements as a camouflage artist ; but in what has been written we have merely touched, as it were, the fringe of a vast topic, to which the novice may direct his attention, in the confident expectation of making fresh discoveries.

The beginning of the first transformation of the Peacock Butterfly, i.e. from the caterpillar to the chrysalis state:
1. Six hours before the change began. 2. Thirty seconds after the change began.

# 3.—TRANSFORMATIONS OF A BUTTERFLY

By T. M. BLACKMAN

With photographs by the Author

THOUGH it is a matter of common knowledge that a butterfly before attaining the winged state has to pass a great part of its life as a caterpillar, comparatively few people have ever thought it worth while to watch for themselves the successive changes right through from the time the caterpillar ceased feeding until the emergence of the butterfly. Yet this transformation, which goes on daily all around us through the spring and summer of each year, is one of the most interesting of the many wonderful processes of nature.

In the case of some groups of butterflies, the caterpillar, before changing to a chrysalis, hangs head downwards, bound to its support by a silken girth around its body as well as by the "tail." In other cases the change takes place upon or below the surface of the ground, or sometimes, as in the case of the "skippers," in a silken cocoon between leaves or grasses, similar to that formed by many caterpillars of moths.

For the purpose of photographing the transformations, a butterfly has been chosen belonging to the family *Nymphalinæ*, which includes such familiar insects as the fritillaries, tortoiseshells, and red admiral. In this family and that of the *Satyrinæ* or "browns" the caterpillar chooses some firm object, a leaf or stem of some convenient plant growing near, and spinning on to it a pad of silk, hangs head downwards during the chrysalis stage. While casting off the caterpillar skin, from the head upwards, the insect has to withdraw the extremity of its body and engage a group of minute hooks into the threads of the silken pad before completely

3. One minute later. 4. One minute later. 5. Forty-five seconds later.

6. Fifteen seconds later. 7. Fifteen seconds later. 8. Forty seconds later.

9. The chrysalis case bursting.

10. Twenty seconds after change began.

11. Seventy-five seconds later.

12. Seventy-five seconds later.

13. One minute later.

14. Two minutes later.

The second transformation, i.e. from the chrysalis state to the perfect butterfly.

15. Three minutes later.

divesting itself of the skin. Fig. 5 of the series of photographs shows the insect arrived at this critical stage. The under surface of the last three or four sections of its body are still attached to the inner surface of the skin when the terminal section is withdrawn. Then, by means of what is evidently a most strenuous effort, the "tail" is thrust upwards, the insect writhing and exerting all its energy, until eventually, if it is successful in overcoming this difficult and dangerous period of its existence, the hooks are safely engaged among the threads of the silken pad. Fig. 6 shows the insect endeavouring to attain this end. The moment its object is achieved and the insect knows that it is attached to a firm support, by means of violent shaking and twisting the caterpillar skin is cast off and falls away. The same movement attaches the hooks the more firmly in the silk and ensures the safety of the insect. Immediately after casting the skin the chrysalis is of a light green colour, and until the new skin becomes hardened is very susceptible to injury.

The time passed in the chrysalis state varies in different species, and is also influenced by climatic conditions. Whereas in temperate climates some species always pass the winter in the egg state, others continue as a caterpillar, and others again as a chrysalis, there are a few which pass the winter as a butterfly; becoming torpid after hiding away in some sheltered position. A barn or haystack or hollow tree is often chosen for this winter sleep, and the eggs are laid after coming out again in the spring. Such species, of which the peacock butterfly is one, usually pass only a short time, perhaps only ten or fourteen days, in the chrysalis state, during the summer.

The emergence of the butterfly generally takes place in the early part of the day, and the second series of photographs shows the process so well that no description is necessary. The wings are limp when newly developed, so the insect rests with them hanging downwards for two or three hours, after which they become dry and serviceable, and our butterfly, which was once a crawling grub, has now become a thing of beauty and graceful motion.

16. Two or three hours after the change began the perfect insect is on the wing.

*Photo: F. T. Newman.*

Swallows when assembling for the autumn migration frequently congregate on the telegraph wires just before the impulse for movement quickens.

# 4.—THE SWALLOW AS A MIGRANT

By A. LANDSBOROUGH THOMSON, O.B.E., D.Sc.

IT is here proposed to take the swallow as a typical example of a migratory bird, the subject of bird-migration, more especially in its British aspects, having been already discussed on more general lines in a previous chapter. The swallow is indeed for most people in this country the proverbial migrant, and scientifically it serves as a useful type. It presents a relatively simple case, that of a summer visitor and bird of passage which is altogether absent in winter from these latitudes, as compared with such common migratory species as the song-thrush and the starling which are represented in the British Isles throughout the year.

The complete absence of the swallow in winter makes the fact of its migration obvious to all, unless the alternative of " hibernation " be taken into account. The view that swallows and other birds hibernated, and even hibernated in the mud at the bottom of ponds, was indeed credited by many good naturalists in the not very distant past ; even Gilbert White of Selborne was not free from the delusion, and the famous anatomist, John Hunter, thought it worth while to seek evidence against the belief by the experiment of confining swallows in autumn in a conservatory provided with tubs of water and mud. Even at this day the idea dies hard in the countryside, and every now and then some fact, such as the finding of a dying bird in a hole or the appearance of an exceptionally early or late bird in a spell of mild weather, is cited by the credulous as evidence in its favour. Scientifically speaking, the hibernation view has long since been exploded, however, and so much is now known of the actual migration of the swallow that there remains no excuse for invoking a highly improbable theory as an alternative explanation of its winter absence.

Although much is now known of the swallow's movements, it remains true that

the ordinary observer can seldom note more than the annual appearance and disappearance of the birds. One day in spring a few are noted flying about ; then no more may be seen for a few days. Again a few appear, and the numbers gradually increase until the locality has its full complement for the summer. In the busy months that follow, two or occasionally even three broods of young are reared, and then the time of departure is at hand. This is heralded by much activity and excitement, the birds tending to gather in large flocks, which may be seen perching on the telegraph wires or going to roost in the reeds. A diminution in numbers soon becomes apparent, and at last all are gone. Occasionally stray birds may be seen at unusually late dates, and a few trustworthy records for December and January show that survival during a mild winter in this country is not an absolute impossibility.

*Photo : Stanley Crook.*

Very soon after their arrival the Swallows become engaged in family cares, and a parent bird feeding its young is a common sight of the later summer.

On the coast or on some island one may sometimes see migration actually in progress, for the swallow frequently travels by day, and one may then observe a succession of small bands following each other in a steady stream and in a constant direction, flying at a deliberate pace low down over the land or water. These, however, are but occasional glimpses of the great movements involving millions of birds ; but much has nevertheless been learnt from piecing together observations of this kind made at different places, especially at lighthouses and lightships, and much also by collecting notes of the various dates of arrival and departure throughout the country. These studies of mass movements are now in their turn being supplemented by the records of individual birds marked in accordance with the method already described in a previous chapter. What, then, are the facts now known to science as regards the migration of British swallows ?

Before the end of March a few early arrivals may be noted, but it is usually at the beginning of the first week in April that the first birds appear in the south-west of England, and at the end of that week that the first birds reach Ireland. At the beginning of the second week in April swallows arrive in the south-east of England, and at the end of that week and in the middle of the third week the south-west and south-east of Scotland respectively receive their first birds. In the north of Scotland the swallow is not usually noted until the fourth week of April, and in the Orkney Isles not until the second week of May. The immi-

Photo: Stanley Crook.

**HOUSE MARTINS GATHERING MUD FOR NEST-MAKING.**

The Martins start their building operations immediately on their arrival in the spring, and like the Swallows, generally return unerringly to the neighbourhood of their previous nesting places.

gration appears to occur along the whole length of the south coast of England, but first and chiefly on its western half, and the earlier dates for the western districts than for the corresponding eastern ones will be noted. These dates refer to the arrival of the vanguard ; the main body is usually some ten or twelve days behind.

The swallow, however, is not only a summer visitor to the British Isles, but also a bird of passage on its way to countries still farther north. The movement of these birds through our area, mainly up the east coast of Great Britain, begins at the end of April, while our own swallows are still arriving, but continues until nearly the middle of June.

Late in August southward movements within the country begin, and early in September the first swallows cross the Channel on their return journey. The birds leaving this country are soon mingled with others passing through from Northern and Central Europe, reaching our coasts from the north, north-east, and east, and it becomes difficult to distinguish the two movements. By the end of October all but occasional stragglers have left us or passed through.

So much the study of mass movements has taught us, but it tells us little of the winter destination of our swallows as compared with those from other parts of the species' wide summer area. In summer the swallow is found in north-western Africa, throughout Europe, and in western Asia ; in winter it is found in tropical and southern Africa, and also in India and its outlying islands. Do the birds native to Northern Europe go to tropical Africa, while those breeding in north-western Africa make a journey of somewhat similar length to the Cape ? Or do the birds from the extreme north also go to the extreme south, while those breeding in north-west Africa perform only a short migration to the tropics ? The question is an important one from the point of view of the nature of the migratory habit and of its possible origin, a subject already referred to in our previous more general consideration of bird-migration. Up to the present, however, only a partial answer can be given as a result of such records as have already been obtained by the method of bird-marking.*

*Photo: J. T. Newman*

Young Swallows make their early migratory journey at the end of their first summer. Two or even three broods are hatched during the few months of residence here.

* Most of the records to be mentioned here relate to birds bearing rings marked " Witherby, High Holborn, London " (and a number), under the scheme organized by Mr. H. F. Witherby, Editor of the ornithological magazine *British Birds*.

*Photo: F. T. Newman.*

The time of departure is heralded by much activity and excitement. A diminution of numbers soon becomes apparent, and at last all are gone.

Swallows have been marked in this country both as nestlings and as adults caught on their nests, and the records of the recovery of such birds are beginning to give us indications of their southern route and winter destination. The work is necessarily slow in bearing fruit, however, for less than one per cent. of the swallows marked are ever heard of again. Of swallows marked as nestlings in Lancashire, one was reported in the Isle of Wight in October of the same year, and one in Central France in September; two similarly marked in Staffordshire were found respectively in south-western France in October and in Brittany in December, the latter bird having probably been dead for some time before discovery. A third Staffordshire nestling was recovered in northern Spain when on its way north again in March of the following year. Two continental records may also be mentioned, namely those of a swallow marked in Schleswig-Holstein and recovered on the Lake of Constance, and of one marked as a nestling in Holland and recovered in Morocco on the 1st of October of the same year.

Thus we have evidence of migration through France and Spain and, with the Dutch bird, Morocco, but after that there

is as yet a long gap in our knowledge. The next records are indeed from the far southern winter-quarters themselves. Five of these records are of swallows marked as nestlings and recovered in their first winter : a Berkshire bird in Cape Province in January, a Lancashire bird in Cape Province in February, an Ayrshire bird in the Orange Free State in March, a Yorkshire bird in East Griqualand in February, and a Stirlingshire bird in the Transvaal in January. The sixth record is of an adult marked in Staffordshire and recovered in Natal in December of the second subsequent winter. That some at least of our native British swallows reach South Africa in winter—our winter, but summer there—is thus established beyond all doubt. Curiously, all the six records are for the eastern portion of South Africa, but what significance can be attached to this fact still remains doubtful, and in the meantime we can only await with interest the recovery of some birds at intermediate points which will give us an indication of the route which is followed round or across the African continent.

There remain some further records which are by no means without interest in their own way, records of swallows recovered in this country in subsequent summers. Twenty marked as nestlings and six marked as adults have been recorded in this way, and, except for three of the nestlings, all of them were recovered at or near the respective places of marking ; sometimes the return to the same place was very exact, to the identical porch or outhouse, while in other cases it was to some other place in the same district and a few miles away. Of the three exceptions mentioned, the most prominent was that of a bird marked in Stirlingshire and recovered in Yorkshire ; but even return to within 170 miles of its birthplace seems a relatively accurate feat on the part of a bird which has migrated half across the world and back before it was ten months old !

*Photo : P. Webster.*

The House Martin—one of the Swallow family—gets busy with its household affairs very soon after its arrival in the spring.

The Rook, though usually slow and deliberate in flight, is nevertheless a graceful aerial performer. One is here caught by the camera in the process of "banking" while approaching its nest.

# 5.—THE COMMUNITY OF THE ROOKS

By CAPT. C. W. R. KNIGHT, M.C., F.R.P.S.

With photographs by the Author

THERE is always a certain romantic attraction about a rookery even as seen from *terra firma*, and a distant view of the jolly rooks, as they return after an absence of some eight or nine months to repair the remains of last year's nests, arouses, in the younger generation at least, something of the excitement that greets the arrival of the first cuckoo.

An exceedingly common bird, and one, moreover, that loves to nest near human dwellings, the rook affords opportunity for everyone to become acquainted with its black form, artful movements and cautious habits ; which characteristics, indeed, contribute to the reputation for extreme wariness and cunning that it so well deserves.

Without doubt the rook, although he may often be seen searching unconcernedly for grubs and larvæ in the meadows close to the highway, is a bird which it is exceedingly difficult to outwit—whether the hunter be equipped with gun or camera. In fact, so famous is his wiliness that the writer, who was particularly anxious to obtain photographic records of his home-life, was almost deterred from embarking on the task after consulting his ornithologically inclined friends and listening to their views on the hopelessness of the idea.

The fact that rooks love to nest at the top of almost inaccessible trees presents an additional difficulty ; for one cannot hope to secure satisfactory pictures when the camera is attached to a branch which sways perilously at each gust of wind.

However, enthusiasm is apt to engender optimism, and will at times overcome seemingly insurmountable obstacles ; so the day at length arrived when a rookery was selected for the work on hand.

The first difficulty that was encountered was that the trunk of the least impossible tree, one far too large to be encircled with

The Rook's nest is built in the top-most branches of high trees, and so firmly twisted and interwoven is the structure with its support that it serves its purpose for several seasons in succession.

the arms, was bare of branches for some twenty feet, whilst the little side-growths which sprouted from it were incapable of bearing the weight even of the youths of the neighbourhood, much less that of a thirteen-stone man.

At length, however, it was found that a branch, which grew out and curved earthwards to within some ten feet of the ground, was sufficiently stout and flexible to support the weight of the writer, who, by ascending hand over hand, started on his journey towards the nests. As soon as the main stem was reached the task became less strenuous, for occasional branches formed convenient hand- and foot-holds.

Almost at the extreme top of the tree, and immediately below a cluster of nests, the increasing thinness of the branches suggested that it would be unwise to proceed farther. From this elevation, however, looking almost due north, it was possible to see into a couple of nests, some six feet apart, and both about twelve feet distant. One of these contained eggs, and the other newly-hatched young.

The direction and position of these nests seemed satisfactory, and the writer, mentally noting the slope and possibilities of the branches to which he was clinging, proceeded to stretch across a fork of the branches a piece of sacking about as large as a fair-sized handkerchief.

This first stage, the foundation-stone as it were of the observation post, having been duly arranged, the return journey to earth was begun. During the operation most of the rooks circled overhead with angry and terrified caws of remonstrance. Some of them, however, perhaps less anxious for the welfare of their families, or more inclined to lethargy, settled on the marshes a quarter of a mile away until the cause of their disquiet had climbed down to the lower branches.

As might be expected, some considerable

time elapsed before the rooks of the selected nests plucked up courage to return to their homes. They seemed to regard the unusual piece of sacking as a trap which should not be approached without careful investigation.

At length, no doubt gaining confidence from the fact that the majority had quietly resumed normal conditions, they overcame their nervousness, and after spending some time hesitating on the threshold, at last decided to settle down upon their nests.

Two days later, when the rooks had grown quite indifferent to the piece of sacking, the tree was once more ascended. Unsteady branches were lashed firmly together, and more and larger pieces of sacking were hauled up and formed into an extension of the first. When this next step had been completed, the rooks, as before, spent some time in overcoming their natural fear of the unfamiliar object.

So by slow degrees the observation post approached completion. At the end of some three weeks it looked, from below, very much like part of a derelict Zeppelin decorated with branches and foliage. It was now only necessary to fix into position the piece of wood that was to serve as a seat, in order that close range observation might be enjoyed without further delay.

There was still much to be done before we could think of trying for actual photographs. In the first place a platform for the camera had to be devised—a platform that would not unexpectedly part company with the branch to which it might be attached; one also that would be perfectly rigid even after it had been in position for several days, and that might be raised and lowered from a hinge so that it would be horizontal to the ground without being necessarily at right angles to its supporting branch.

The day arrived at last when an attempt

A small section of a "Community of Rooks" showing the close proximity of the nests in one tree. It well illustrates the gregarious habits of the bird.

was to be made to secure the coveted pictures, and armed with camera and numerous dark slides we set out for the rookery.

The act of climbing the tree is exhausting at the best of times, but with the camera strapped to one's back it is even more so, yet if we adopt the alternative method, first climbing to the observation post, and himself with the camera inside the observation post, the rooks, having seen him climb the tree, are pursuing their usual routine of soaring over the trees or of collecting in a crowd on the distant marshes, where they are likely to remain until they see him descend again to earth. The only way of deluding them, I found, was to bring a com-

A photograph which shows the Rook's characteristic pouch below the beak in which food is collected.

then attempting to haul up the camera on a rope, we shall find ourselves beset by intervening branches that may impede the progress of so awkwardly shaped an instrument.

No matter what method we adopt, however, we are certain to experience some trying moments during the elevation and arrangement of the camera. It is incredibly difficult to manipulate things so that the lens is really pointing in the right direction ; so that the camera itself may really be rigid, and so that the dark slide may be withdrawn without catching in canvas or branch.

Whilst the photographer is thus busying panion whenever photography was to be attempted. So that he, by throwing his hat in the air, shouting and gesticulating, might monopolize the attention of the rooks and cause them to forget the presence of the photographer.

As a rule his antics not only prevent any unusually bold rook from returning prematurely to her nest, and discovering that the observation post is occupied, but also succeed in attracting the attention of passers-by, who find great amusement in watching both his strange behaviour and his consequent embarrassment !

At length, when everything is in readiness

A TREE-TOP QUARREL.

A rookery is by no means a peaceful community. Cunning and contentiousness are the distinguishing features of the Rook's moral outfit.

for the great moment, we may lean back restfully and recover from our exertions. The light is really quite good, although up in the tree-tops there is such a high wind that it seems almost incredible that the rooks' nests can maintain their positions. What an uproar! Nearer and nearer they come. They are without doubt behaving much more amicably than we had dared to expect. First one and then another flashes past the peep-hole, and then, without further preliminaries, one of them swings into

In feeding her young the old Rook transfers from her food-pouch to the tip of her beak small portions of the food which she has collected, and drops them into the open mouth of the hungry chick.

A shout from our companion indicates that his antics are at an end. "I'm going now," he calls, and through a little slit at the back of the observation post we see him—a tiny black object—clambering over a gate and disappearing into the cherry orchard.

For a few minutes we feel strangely alone, swaying about in our tree-top home in complete silence. By the time our companion had started to leave the rookery the last of the soaring rooks had drifted away towards the marshes, where one by one they joined their friends upon the grass.

But suddenly, away from the left, comes a great commotion. The flapping of wings and the hoarse caws in a dozen different keys both tell that the rooks are returning. the tree and settles on a branch some fifteen feet away. There, with lowered head and bright piercing eyes, she stands for a few moments to satisfy herself that the coast is clear before going to her nest.

Before doing so she must approach the observation post even more closely, for her nest is less than twelve feet away—and whether we succeed in getting any photographs or not, we are quite sure to witness some interesting incidents in the home-life of the rook.

Presently, encouraged by the absence of anything alarming, and also no doubt by the fact that the neighbours are already tending their families, she sidles forward along the branch, hops on to the edge of

the nest, and puffing out her breast feathers, prepares to brood her eggs. The ability thus to raise her breast feathers so exposes the bare patch on a sitting bird's breast—known as the " sitting patch "—as to allow the eggs to come into direct contact with the naked skin, the feathers closing round the eggs when the bird is in position.

Having arranged herself comfortably our rook interests herself in the goings on in the neighbouring nests. As she turns her head from side to side, the glossy feathers of her neck literally sparkle in the sunlight. What a mistake it is to imagine that the rook is black! As her feathers catch the light they are every colour—an iridescent sheen of blue and green and purple.

A vociferous *caw-w-ing* from the nest on the left indicates that the young ones are being fed. Peering through a second peep-hole, we can see two sturdy young ones vying with one another to secure the portions of food that the old bird, standing over them, transfers from her food-pouch to the tip of her beak. As she presses the food affectionately down the happy youngster's throat we notice that his delighted *caw-w-ing* merges into a stifled gulping sound, humorously expressive of his struggles in calling and swallowing at the same moment. The second young one, meanwhile, has to wait until the process of transferring food from pouch to beak is once more accomplished before he, too, receives his little portion.

Having distributed the consignment the old rook seems inclined to brood her family, and for some time tries unsuccessfully to wriggle herself into position above them. At length, however, finding it impossible, she contents herself with lying on the nest beside them—very much in the same fashion as a barn-door chicken turns on its side when dusting itself.

Now the sitting female on the right hand

A striking point of difference between the Rook and the Crow is the bare patch of skin at the base of the beak, which is clearly visible in this photograph of an adult Rook.

nest is about to be fed. With half-spread quivering wings and excited *caw-w-ings* of anticipation, she awaits the coming of the male, who seems, however, in no great hurry to deliver his gifts ; in fact, some little time elapses before her eager cries are merged into the prolonged gulping sounds.

As the hours pass the two large young rooks on the left-hand nest are evidently contemplating a first trip into the Great Unknown, and standing on the edge of the nest, flap their wings energetically, to test, as it were, their weight-carrying capacity.

At last, one at a time, they take the fatal leap into space.

Their first flights are short—just a few yards to neighbouring branches—but they soon flutter upwards, and may be seen a few hours later at the extreme top of the tree, where they are rewarded with food by their proud parents.

As the day draws to a close, we decide to come down to earth once more, a somewhat painful proceeding, for we are cramped and stiff after our long vigil, but at the same time quite delighted with our interesting and successful day.

When half-way across the field, on our way to the cherry orchard, we turn and glance back to see a seething cloud of rooks high in the air over the rookery, and gradually descending towards the clustered nests.

Which particular black form in that swirling mass is our friend of the left-hand nest who tried so pathetically to brood her robust youngsters ? Which one the male who took such pains to supply his sitting wife with food ?

What a busy garrulous community it is—and how anxious is each one to return with the least possible delay to the eggs or young that, lying in the wind-swept nests, are exposed to the cool evening air.

When at last one of their number swings boldly downwards and lands without further ado on the edge of his home, the remainder, no doubt encouraged by his temerity, quickly follow his example, and in a few moments the air above the trees is destitute of rooks.

Now it is the tree-tops that are full of eager, noisy life. Females shuffling over eggs or young ; males intent on stuffing food into the gulping throats of wives ; whilst others—dark specks against a pink-tinged evening sky—sit motionless on some bough near the home, pondering perhaps on the glory of this perfect twilight ; it maybe reflecting thankfully that those noxious humans have at last definitely disappeared.

A curious full-face view of the Rook brooding her hatch in the nest on the wind-swept tree-top.

*Photo: Stanley Crook.*

One of the sure signs of spring's return may be witnessed in the gullery, whither the Black-headed Gulls have repaired.

# 6.—THE REAL HARBINGERS OF SPRING

By CHARLES S. BAYNE

FOR many generations we have been told by the wise men of our race that the cuckoo is the one and only harbinger of spring. The truth is that the cuckoo is the big blustering braggart who comes along after the battle has been fought and won, and makes such a noise about it that he persuades simple-minded people like poets that he has done the whole thing himself. Valiant attempts are made every spring to justify him by people who say that they have seen or heard him at any time from the middle of February onwards. But when we hear these reports it is well to remember that those parts of our coast on which our summer migrants usually arrive are closely watched by maniacs with guns who would give half their lives for the pleasure of bagging a February cuckoo, and who, moreover, would be paid a small fortune for the specimen by equally eager but more wealthy collectors, and yet not a single skin has been produced to confirm any of those premature records. It has been suggested that the cuckoo, like the cock that crows at midnight, pays a preliminary visit about the third week in February just to have a look round and make quite sure he is first, but that finding an astonishing scarcity of hairy caterpillars and an appalling state of misery generally throughout the country, he retires again to his winter home of rest and only returns at a time when a sensible harbinger might reasonably be expected. That is quite possible, and it is also possible that,

like the cock that announces the dawn several times in advance and finally misses it altogether by half an hour, the cuckoo crosses and recrosses Europe at intervals during March, but only decides to remain in England about the end of the second week in April, and proclaims his intention in unmistakable terms several days later. Nevertheless, even if we had authentic records of his arrival in March, the fact remains that the cuckoo is a mid-April bird, whereas there are many early April and several late and mid-March birds that have a better title to the honour of being harbingers.

*Photo: Stanley Crook.*

An ever-popular harbinger of spring is the Song Thrush, which, though not generally realized to be migrant, returns to its old haunts about the middle of February.

The question of which bird is the real harbinger of spring depends to a large extent on locality and on whether or not you are a close observer of Nature. If you make careful records of the comings and goings of birds, you will probably notice a striking scarcity in winter of the song-thrush, which is one of our commonest birds. The fact that this bird is to be seen in our fields and woods throughout the year, prevents most of us from realizing that the majority of the thrushes whose songs we enjoy in spring and summer leave us in autumn and spend the winter farther south, their places being taken for the time being by a comparatively small number that come in from the north. This is most noticeable in upland districts where the countryside is practically deserted by the song-thrushes. About the middle of February, if you live in such a neighbourhood, you will observe that the thrushes have returned to their old haunts, and that skylarks and meadow pipits have taken up their quarters again in pastures from which they have been absent for four or five months. You will be able to record also the reappearance of lapwings, which, however, instead of scattering through the fields, will fly about in flocks, alighting here and there in an unsettled way, and even when feeding, keeping in close company.

In moorland districts the coming of spring is first heralded by the beautiful though somewhat melancholy calls of the curlew and the redshank, which together with the snipe revisit their old nesting grounds about the end of February after a sojourn of seven or eight months on the mudflats of our estuaries; and on the wilder or more remote parts of our coast gannets, razor-bills and guillemots announce the glad

*Photo: Henry Willford.*

**A PAIR OF SNIPE.**

The Snipe return to their old nesting grounds on the moorlands about the middle of February. Note how the feather markings resemble the criss-cross of grass stems.

tidings by coming to roost again on those rocks where they have nested every year for centuries, having passed the winter on some distant and shoreless feeding grounds far out in the North Atlantic.

Almost everywhere the rooks, which, for reasons best known to themselves, roost throughout the winter at a distance from their rookeries, spread the joyful news by revisiting their nests more frequently, and spending more time in their vicinity till the time for building comes with the first Sunday in March. Almost everywhere, because the rook unfortunately cannot now be counted among the resident birds of London. But even here the tale is told by the birds, not by the arrival of long-absent favourites, but by the departure of those that have taken refuge in the metropolis from winter's ravages. After the end of February the gulls, which have been such an attractive and interesting feature of the river and the park ponds, become gradually less numerous, till about the third week of March they are conspicuous by their absence. They have gone off to their breeding places and have carried with them into those parts the news of returning spring. The vast hordes of starlings, too, which since October have roosted on St. Paul's and other buildings in the City, thin out as March advances, and by the end of the month most of them have gone either to more northern districts of our own country or across the ocean to eastern Europe.

*Photo: Alfred Taylor.*

About the third week in March the Pied Wagtail, after wintering in the south, goes northwards to its familiar nesting territories.

During March also, the rooks become noisy and busy with their nesting operations, the lapwings separate and send a thrill through the countryside with their joyful tumbling and calling, wild duck, mallard and teal, and the great crested grebe appear again on the ponds on which they reared families last year, the pied wagtails, which have spent the winter in the

south flocking every evening and roosting in convenient reed beds, move northwards and occupy again their old nesting territories, while the local flocks of chaffinches which for months have fed so regularly on the ploughed fields, break up and settle in preparation for pairing.

All these changes are signs of approaching spring while winter is still with us. Nevertheless, however grateful we may be after the long, dreary dark months for such welcome portents of better times to come, we are not satisfied till we have seen or heard the first of our real overseas migrants, the first of our summer visitors from the sunny south. For most of us these are represented by the swallow and the cuckoo. But long before either of them puts in an appearance several other species have arrived and taken up their summer quarters.

Gilbert White records that every spring he was certain to see numbers of ring-ouzels among the trees on the downs from Chichester to Lewes. The birds, he said, arrived regularly on or about the 14th of March. As a matter of fact, small parties of ring-ouzels usually reach the south coast of England as early as the 12th of March, and the larger flocks come in during the last week of the month and the first week of April.

This handsome bird is a first cousin of our well-known blackbird, but it is practically unknown to dwellers in the greater part of England, except to a few on or near the south coast, for soon after its arrival it

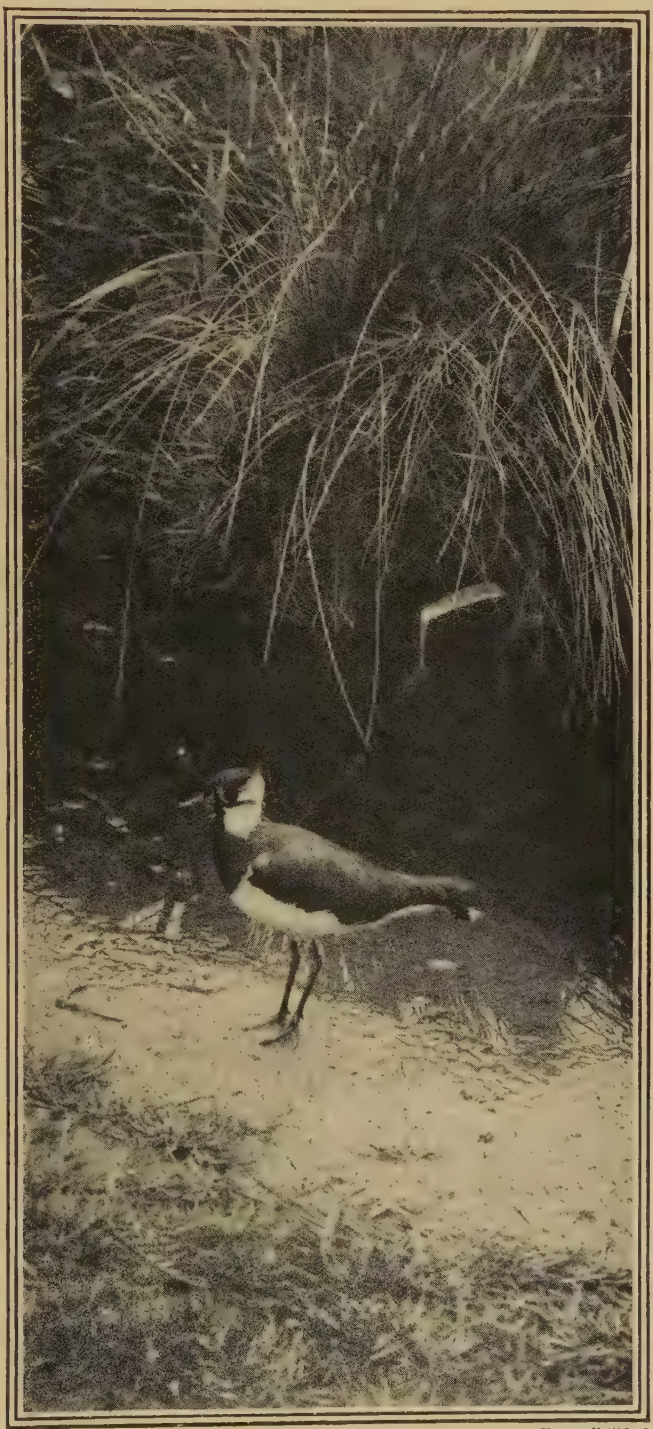


*Photo: Henry Willford*

During March the flocks of Lapwings separate.

pushes on northward into Wales and the moorland and mountainous districts of northern England and Scotland, a number remaining, however, to breed on Dart-

A much more familiar bird is the little wheatear, another member of the thrush tribe, which arrives about the same date as the ring-ouzel. This is also a bird of waste

*Photo: T. M. Fowler.*

A week or so before the vernal equinox the handsome Ring-Ouzel arrives on the south coast of England, and soon departs for the mountains and moorlands of Wales and the north.

moor, which, of course, is well suited to its habits. It is slightly smaller than the blackbird, and while the cock is black (though his colour is not so pure or rich as his cousin's), he may be readily distinguished by the fact that he has a broad white crescent (not a ring, as his name implies) across his upper breast, a decoration which compensates for his lack of the blackbird's orange bill. The country chosen by this species being, of course, for the most part treeless, the nest is placed on the ground or on the bank of a stream, and usually the site is selected near some prominent rock on which the cock, who is an excellent songster, sits regularly and whiles away his leisure moments with a flood of delicious sound.

places, but it is somewhat more liberal in its tastes than its fellow-traveller, for besides moorlands it frequents land bordering on the seashore or the shore itself, also downs, commons, links, and so on. One of its popular names, whiterump, suggests the best guide to its identification, for its most conspicuous feature when in flight is a large white patch on the lower part of the back and the adjoining portion of the tail. The cock has black wings and a black tip to his tail. His head and back are pale bluish-grey, his breast is pale buff and his throat white, while on each side of his head there is a black stripe that passes backward from the bill under the eye to the ear, where it broadens into a blob. So he is one of our

more beautiful birds, and from our point of view it is a pity he has chosen to spend his summers in such uninviting localities. He is not a bit shy, however, and if you go in search of him in suitable places you will not fail to see him any time from the middle of March onwards. He will not avoid you, but will flit along in front of you close to the ground and keeping only a reasonable distance ahead. His white rump flashes as he goes, so you cannot mistake him, and presently he alights on a stone or a clod or a stump and watches you, now and again bobbing and flicking his wings and tail like a robin. So he gives you many opportunities of enjoying his beauty. Only the elect, however, have heard his song, patient watchers who have found his nest (which is usually in a hole in the ground, frequently in an old rabbit's burrow) and have waited in concealment till he has felt quite at his ease.

But a bird that has to be sought can hardly be called a herald. To be entitled to such an honour a bird must come to us and announce himself, and this the cuckoo certainly does. There is one little bird, however, that arrives only a day or so later than the wheatear and the ring-ouzel, and almost a month before the cuckoo, and at once lifts up his voice to cheer our woods and gardens. This is the chiff-chaff, the smallest of our warblers though not our tiniest bird. I have heard him as early as the 14th of March, but an average date for the first arrivals of the species is the 16th. His simple but cheerful little song greets us unexpectedly one morning from the tree-tops, and not necessarily on "the first mild day of March," for almost as regularly as the clock this mite braves the rigours of our northern climate and, provided the day be not bitter, pipes his glad tidings to the world at large and all day long. *Chiff chaff*,

*Photo: Henry Willford.*

The familiar little Wheatear appears almost simultaneously with the Ring-Ouzel, and is also a bird of the waste places.

*chiff - chaff, chiff - chiff - chaff, chiff - chaff-chaff*, he sings, announcing plainly to those that have ears to hear, "Cheer up, spring will be here in three or four days." If our poets had been really observant people they would have sung the praises of this little bird, but strange to tell, even so late as Gilbert White's time he had not been given a name. Yet he is the real harbinger of spring, coming as he does and shouting his news at the pitch of his tiny voice while winter has still several days to run. But he has not received his due recognition because most of us have not yet learnt to distinguish one bird note from another.

*Photo: Stanley Crook.*

With his cheerful notes, the Chiff-chaff, the smallest of British warblers, is one of the first arrivals, and may be counted the real harbinger of spring.

Following close upon the chiff-chaff comes the sand-martin, the smallest of our swallows. He is the first of the swallow tribe to arrive, the advance flocks reaching our shore about the 19th of the month, so he is probably the bird that gave rise to the proverb "One swallow doesn't make a summer." He is easy to recognize, for his back is brownish black, whereas the swallow's is blue-black.

Between the first day of spring and the beginning of April the true swallow and the willow warbler, first cousin of the chiff-chaff, may arrive, and then almost every day for four weeks some new species may be welcomed. Authentic records exist of the appearance of the cuckoo in the first week of April, but towards the end of the second week is nearer the mark, and in the south-east of England the 19th is called Cuckoo Day, as he is expected to begin calling on that date.

It is well to remember, however, that the dates of spring arrivals vary according to locality. In this respect the west coast is usually several days in advance of the east, no doubt due to the fact that so many species travel north from Gibraltar by the coast route and so reach the western crossings first. And again, though the first of the chiff-chaffs arrive before the 21st of March, the rush begins about the 25th. This is true also of the other species, for the flocks arrive in a series of waves which may be spread over several weeks.

*Photo: A. M. C. Nicholl.*

The Willow Warbler, first cousin of the Chiff-chaff, arrives from its oversea journey between the first day of spring and the beginning of April.

*Photo: Stanley Crook.*

By OLIVE HOCKIN

# 1. Little Homes in the Orchard.

IT was the twenty-first of March, and Topsy, Popsi and Boodles were still in bed. The sun, who had got up at six, had been staring in at the window for an hour or more before any of the children stirred.

Then a thrush, who was sitting on the bare boughs of an apple-tree, began shouting :

" Come, get up ! Come, get up ! "

Popsi rolled over and rubbed her eyes. Topsy did the same. And Boodles, hearing them move, ran in from his room next door.

And in the blaze of light that flooded the room, what did they see ? Dancing in a patch of sunshine, with yellow hair that swung and fell, and transparent, filmy robes of green and silver, was a fairy.

" Oh ! " cried the children together. " Oh ! Who are you ? "

The fairy stopped dancing. "Why, don't you know ? " she asked, looking a little hurt. " Who could I be but Spring ? Don't you know that I always arrive on the twenty-first of March ? I thought I would just look in at you first of all, but I can't stay long, as I have to go and light the candles on the chestnuts, and then wake up the crocuses."

" Oh, do stay, please ! " cried Boodles, running up to her. But as he reached her she was gone—just a flick of silver scarf was seen at the window, and a laughing, silvery voice floating back on the sunbeams——

" Meet me in the orchard . . after breakfast . . . " were the words they heard, faintly but clearly.

" Come, get up ! Come, get up ! " shouted the thrush again.

Hurriedly, they all began to dress, and as soon as breakfast was over ran out to make the most of the time before the bell rang for lessons.

Topsy, Popsi and Boodles lived in an old farmhouse, and the orchard was their beloved playground, for everything in the world seemed to live and grow there. The twisted apple-trees, reeling down the slope like a band of old brown dwarfs, made homes for all kinds of creatures—bees, birds and insects—in their queer crooks and notches. At the bottom, a spring oozed out of the ground and made a pool, while round the upper side ran a great tangled hedge of trees, twined with briar, and lit with snowy blackthorn and the golden haze of lamb's-tails.

Under the hedge snowdrops had been in flower since February, and all about the slopes were daffodils blowing their little yellow trumpets, while primroses peeped and peered, waiting their turn to join the play.

"Now! Where is Spring?" cried Boodles as the children climbed over the gate.

Photo: Henry Irving.

"All about the slopes were Daffodils blowing their little yellow trumpets."

"Come and see! Come and see!" called the thrush catching sight of them.

"Where? Why, there!" cawed a rook as he flew overhead with a long twig in his mouth. "Where? There!" he repeated.

And sure enough, looking up into the haze of catkins that hung on the nut-tree above them, the children could just make out that fairy form, made of mist and sunshine.

"Well!" she cried, laughing again—she could hardly stop

*Photo: Henry Irving.*

**WHERE THE FAIRIES HIDE.**

"In the haze of catkins that hung on the nut-tree, they could just make out that fairy form . . . ."

laughing that day. "Tell me how many nests you have found in this orchard!"

"We didn't think there were any yet," began Topsy.

"I thought as much!" said Spring. "Here am I, only arrived a few hours ago, and I've found twenty-three already."

"Oh!" gasped Topsy.

"Oh, do tell us where they are!" cried Popsi, beginning at once to climb up the hazel tree.

"Now, come quietly!" said Spring. "And before I introduce you to anyone, you must promise that you will never disturb the nests. For if you are careless and frighten the birds, I shall never show you anything again."

"Mayn't we take any eggs at all?" asked Boodles.

"No, indeed!" said Spring. "After the birds have had all the trouble of making the nests and laying the eggs—I should think not! You will find it ever so much more fun to watch the little ones grow up. Now, you are going to promise, aren't you?"

"Why, yes," said Topsy for the rest. "We'll promise, solemn-on-our-honour!"

"Well, then," said Spring, "just look into that furze bush! When you see what is there, I am sure you won't want to take eggs any more!"

The children clambered up the boughs of the nut-tree till they could see—what *you* will see in the picture below!

"And that's what the thrush is shouting about!" said Spring. "Those are his babies, just hatched this morning."

*Photo: R. A. Malby.*

Four wide-open, yellow caverns stretched on the end of four long, skinny necks.

A PIKE ON THE LOOK-OUT.

*An under-water Autochrome by Dr. Francis Ward, F.Z.S.*

# Strange Facts of Fish Life

The Pike resting on his fins outside a reed-bed. The muscles of the back are relaxed, and the dorsal fin is almost flat.

## 1.—EXPRESSIVE ATTITUDES OF FISH

By DR. FRANCIS WARD

With photographs by the Author

THE majority of people, even among those engaged in nature study, take very little interest in fish life. This is probably because they have not had an opportunity to observe their habits in a wild state.

Goldfish in a bowl or pollack in a sea-water tank, aimlessly cruising round and round, certainly do not arouse enthusiasm. But the observation of fish in their natural surroundings from under water, with the observer unseen by the fish, throws a totally different light on the subject.

Under these conditions it is possible to appreciate the true value of the various schemes for offensive and defensive concealment; to recognize by their attitudes and movements the various sensations of fish, such as alarm, excitement, depression, and to understand the reason for many of their habits.

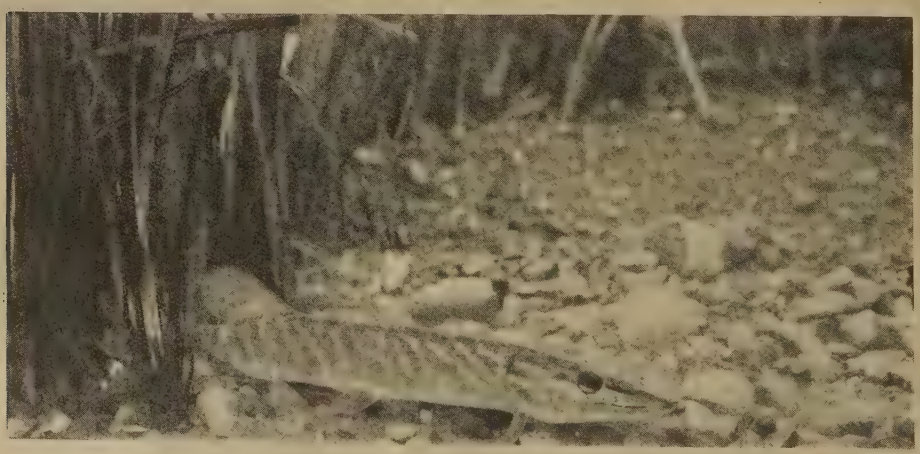
We live with our horses, dogs, and cats, and have unconsciously noted their attitudes, movements and expressions. These are indications of thought and intention. For example, if a cat is seen beside a bush in the garden with her eyes glued on some object, motionless except for a spasmodic twitch of the end of her tail, it is clear that she is watching a bird. The cat reveals her suppressed excitement by the jerky movements of the end of the tail. If your fox-terrier, as he goes out of the gate, suddenly drops on the ground with his front legs straight out and his head resting between them, one may be sure he has spotted a pal, and in another moment will bound forward to have a romp. Had the dog suddenly pulled himself together and advanced on his toes with stiff and stilted gait, the hair on his neck erect, and his tail quivering, it is certain that he was intent on a fight.

While a shoal of Dace are feeding and remain on a level keel they are invisible to the predatory pike; but here and there one turns on its side, with the result that its silvery body, acting as a mirror, reflects the light, and betrays its whereabouts to the Pike.

The attitudes and movements of the cat and the dog convey to us the intentions of these animals, because we, by custom, have learnt to read them. In the same way the fish observer can read the intentions and mental state of fish by the movements of their fins and bodies, their attitudes and their changes in colour.

I show five illustrations of the same pike in various positions. In the first photograph the pike is resting on his fins outside a reed-bed. The muscles of the back are relaxed and the dorsal fin is almost flat. In fact, he is in a state of rest until such time as a shoal of small fish come sufficiently near to afford an attack a reasonable prospect of success.

A shoal of dace may be feeding in the distance. While all the fish remain on a level keel they are invisible to the pike; for their silvery bodies, acting as mirrors, reflect the tone and colour of their general surroundings. But here and there one turns on his side while feeding, and in consequence his other side catches the light from above. Immediately there is a flash. The attention of the watching pike is at once arrested. The manner in which he reveals this fact is by erecting his dorsal fin and keeping it rigid, while betraying no movement of any other part of his body or fins.

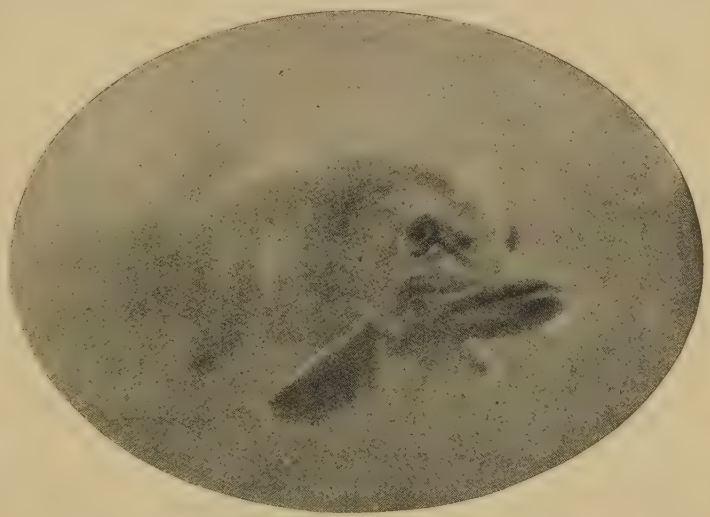


The watching Pike reveals the fact that he has seen the Dace by erecting his dorsal fin, while betraying no movement of any other part of his body or fins.

Should the Dace continue to cruise round, the Pike, propelled by a screw-like action of his caudal fin, rises from the ground, and glides slowly with rigid back towards the shoal.

If the dace continue to cruise round, the pike rises off the ground, and, propelled by a screw-like action of his caudal fin, glides slowly with rigid back towards his intended prey. Should the shoal become alarmed, the pike stops at once and hangs motionless in the water, except for a rapid vibration of his pectoral fins and perhaps a movement of the back rays of his dorsal fin, which are swished from side to side, or rapidly closed and opened. The pike in this position is rigid and quivers with excitement. It is a fine example of restraint, there is only one thing for him to do—keep absolutely still. A rush forward at this stage of the attack would only spell disaster, for the little fish would scatter and the pike go without a meal.

As soon as the shoal, by their movements, show that their confidence is restored, the predatory pike continues his stealthy approach. Within striking distance he suddenly looms upon them, makes a quick rush, and one of the shoal has been seized across the middle. The captured fish is then jerked round, and goes head first into the mouth of the pike, while a swirl on the surface of the water is the only indication to the upper world of the under-water tragedy.



The predatory Pike continues his stealthy approach towards the Dace, and when within striking distance suddenly looms upon them.

Should his prey escape, the Pike's muscles relax and, angrily snapping his jaws, he sinks to the bottom, a disgusted and disappointed fish.

Should the final rush fail and the prey escape, a complete

change comes over the pike, his muscles relax and, angrily snapping his jaws, he sinks down to the bottom, a disgusted and disappointed fish.

Most fish show their aggressive intentions or alarm by erecting their dorsal fin or fins.

The Perch slowly swimming through the water has its second dorsal fin so flat over the back that it can scarcely be detected. The first dorsal fin is erect so as to act as a keel.

In many the dorsal fin in this position becomes a weapon of defence, for the fin-rays are extended beyond the web as spines—in some cases of a formidable character.

The perch has been taken as an illustration, though in this fish the spines are not large, yet they can inflict a nasty wound. On one occasion when I was sailing on the Norfolk Broads our boat passed a man who was evidently into a nice fish at the mouth of a dyke ; so we " came to " to watch him land it. After a considerable amount of play he brought a perch to the surface, and as I was not the man that lost that fish, when I give its approximate weight as a pound and a half, my estimate will probably be accepted. After some difficulty the net was passed under the exhausted fish. The captor held the beautiful specimen in his hand to admire it. Suddenly the perch flung out his armed fin and scored a nasty gash in the hand of the angler, who dropped him on the bank. One or two violent flaps and the fish was back in the dyke.

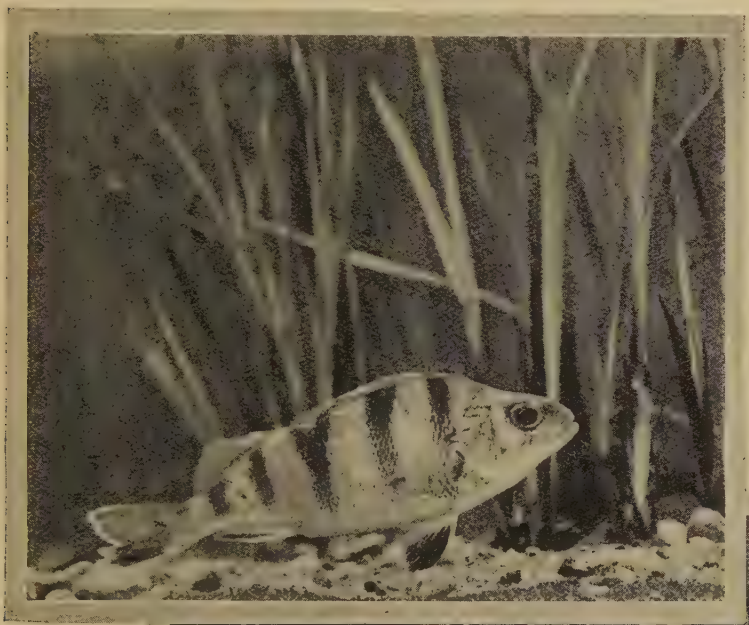
I have been led to believe that in the land of sport the golfer is the most expert in expressing his resentment of misfortune. That angler must also have been a golfer !

Three illustrations of the perch are given. The first shows the fish slowly swimming through the water. The second dorsal fin is so flat over the back that it can scarcely be detected. Incidentally the positions of the other fins are interesting. The first dorsal fin is erect so as to act as a keel, and it is obvious that the progress of the fish through the water is due to the lateral movements of the caudal fin alone.

The perch then sank down and rested on the bottom outside a reed-bed, using his pectoral fins as legs, in a similar manner as shown in the case of the pike. The same fish while in this position was intentionally frightened, and at once showed its alarm and readiness to defend itself by erecting both dorsal fins. The spines can easily be detected, though, as already stated, they are small. The ruffe is the other

member of the perch family in our waters, and in this fish the spines on the first dorsal fin are much larger and quite formidable weapons.

A very interesting point is where a perfectly harmless fish strikes a ferocious attitude, and through pure bluff warns off its aggressor. In the cottus or father-lasher, all the fin rays end in spines, and the gill covers are also armed. When alarmed this fish spreads out his large pectoral fins, erects the fins on his back, puffs out his cheeks, and strikes a truly terrifying attitude. Side by side with the cottus is found the blenny, a soft, slimy, defenceless fish. When attacked, it assumes an attitude quite as ferocious in appearance as the cottus. Experience has taught predatory fish in the sea that the cottus is not a comfortable mouthful, and so he is left alone. Blennies are very plentiful all round our shores, and as they are not particularly active nor particularly well protected by colour or markings, we may fairly presume that they are mistaken for the cottus and thus escape.



The Perch sank down and rested on the bottom outside a reed-bed, using his pectoral fins as legs, similarly to the Pike shown in the preceding photographs.

While in the above position, the Perch was intentionally frightened, and at once showed its alarm and readiness to defend itself by erecting both dorsal fins.

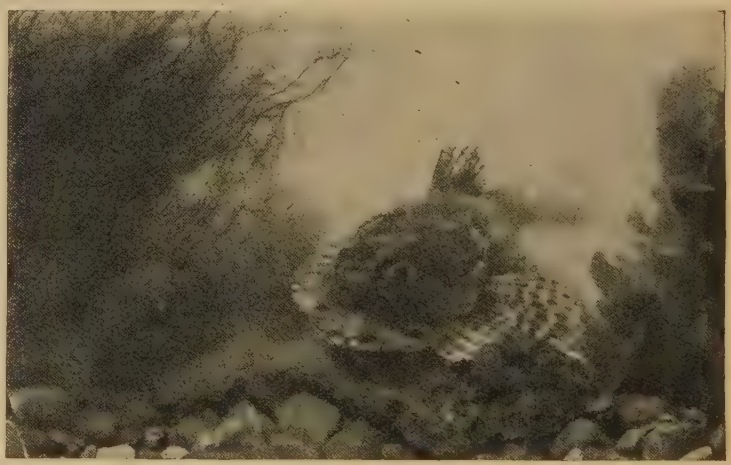
All the attitudes and schemes as described have been in the interests of the fish itself.

Devotion to its progeny, when the latter is menaced, is another quality that prompts a fish to assume a defensive attitude. No better example of this can be found than

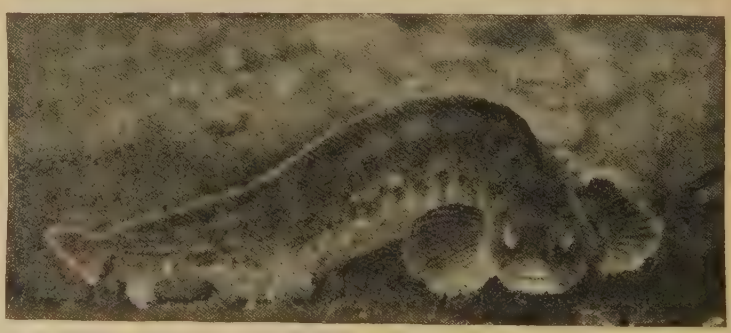
Combative attitude of the Ruffe, which raises the spines on the first dorsal fin as a weapon of defence.

that of the three-spined stickleback. In this little fish three formidable spines represent the first dorsal fin. The male fish alone builds the nest, and takes, apparently, sole responsibility and not a little pride in the rearing of his family.

The nest he makes is a tube of vegetable matter, built on the ground, with one end closed. When it is completed this determined parent drives a female into its seclusion and keeps her there until she deposits her quota of eggs. After accomplishing this she is allowed to bore her way through the closed end, thus converting the nest into a tube. Further females, one after another, to the number of five or six, are treated similarly, and forced by the male into the performance of their natural duties. At last some eighty eggs have been deposited, and the male, satisfied, proceeds to mount guard over his property. Should an enemy approach too near, up go the three sharp spines, and with ferocious mien he defends his nest. If for a moment he is absent, marauders of all kinds — minnows, sticklebacks, even the females who laid the eggs —will swarm around, tear the nest to pieces, and devour the contents. The devoted male must therefore remain on duty night and day, and what with constant attention, periodic fights, and the fact that he cannot wander far in search of food, he grows thinner and thinner, and not infrequently the hardworking parent will die as a result of his unremitting devotion.



The Cottus or Father-lasher, a perfectly harmless fish, when alarmed strikes a ferocious attitude by spreading out his large pectoral fins erecting his dorsal fins, and puffing out his cheeks.



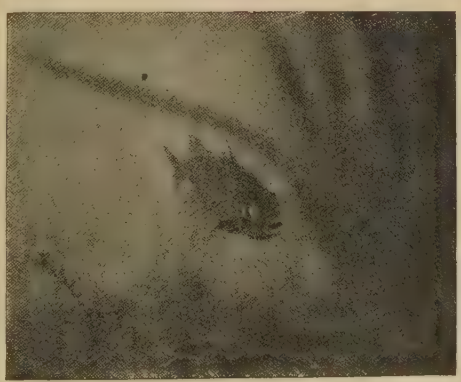
When attacked, the Blenny—a soft, slimy, defenceless fish—assumes a warning attitude quite as ferocious in appearance as that affected by the Cottus.

The male Stickleback builds a nest of weed-stems and other debris, which he pieces together with mucus from his own body.

When his blandishments fail upon the female of his choice, he gets annoyed, and drives her to the newly-made nest.

Female Sticklebacks eat their own eggs when

the vigilance of the male is relaxed.



A Stickleback on guard near its nest.

# By-Ways of Plant Life

## 1.—THE UNFOLDING OF THE LEAVES

By G. CLARKE NUTTALL, B.Sc.

With photographs by the Author

NEVER was there such an unfolding, unpleating and uncoiling as takes place when the infant leaves begin to grow up under the stimulating warmth of the spring sun. If the eye could only perceive what is then going on, one would conclude that the secret of perpetual motion had been solved, for every leaf is, after some fashion or another, unwrapping itself as it grows, and the number of ways in which this is done is truly amazing. The infant leaf, like the human infant, is a very tender thing and needs every possible care against cold and wet, so, just as a baby is wrapped in clothes, the baby leaf is carefully folded or rolled, or guarded in the embrace of an older leaf; and, of course, as it grows to maturity these wrappings and rollings have to be unwound each in its own particular fashion.

The Violet leaf in infancy is curled into two rolls on to its face, which rolls gradually uncurl.

In both the primrose and the violet, for instance, the infant leaves are rolled up lengthwise in twin rolls, but of these, the primrose leaf is rolled *backwards* so that the twin rolls lie behind the midrib, while the violet leaf is rolled *forwards*, the rolls lying on the centre of the face. To see the tight crinkled rolls of the primrose uncoiling one must turn the leaf over and look at the back—for nothing of the process can be seen on its face except the gradual widening of that face—while in the violet the coils roll back like curtains disclosing the face of the leaf. The crocus and the large dock leaves follow the method of the primrose; the little pink begonia in somewhat primmer fashion has adopted that of the violet. Why these leaves should have developed these divergent methods is a mystery, which is not solved by saying that the face of the one or the back of the other is more fitted

The Primrose leaf starts life curled up into two crinkled rolls on its back. As it grows these uncurl.

The Arum leaf unfurling like a flag.

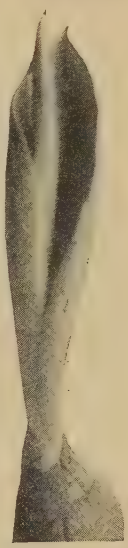
to bear the brunt of the weather, for probably that is the effect and not the cause of their choice. Each plant has its own individuality and its own lines of development.

Again, take the leaf of the arum lily—and the leaf of the wild arum which follows its lordlier brother. In these the leaf is curled as a flag is furled, one side being wrapped round the other, as if the leaf were hugging itself for warmth. In the common aspidistra of every villa window the leaf rolled on itself is like the conical paper bag of the sweet-shop. In the tulip there is added a very pretty protective touch, because each leaf encloses within its embrace a still younger one. It reminds us of some little child-mother of the streets wrapping her own shawl about her baby brother to guard him from the cold.

Of all the unrollings, perhaps the most remarkable is that of the ferns, for here, unlike almost all other leaves, each frond and also every part of each frond, is wound up from apex to base like so many watch-springs, and as the fern grows from infancy to maturity all these watch-spring coils are unwinding at the same time. If one could only see it magnified and "speeded-up," cinema-wise, what a whirl of unwindings would be before us!

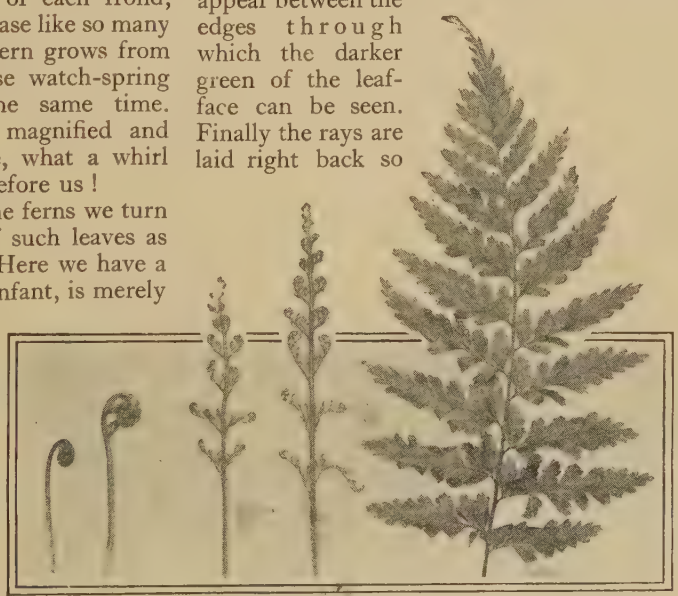
From the complexity of the ferns we turn to the extreme simplicity of such leaves as the cherry and the peach. Here we have a plain oval leaf which, as an infant, is merely folded in half—the hinge being the midrib. Each half is so exactly laid on the other half that often it is quite difficult to tell at first that there are two layers; sometimes the surfaces are so sticky that they are really glued together. The leaves frequently reach a considerable size before they open, like a book, and lie out flat.

In the rose leaf, and in many others like it, each leaflet is folded in half, with the leaflets laid together neatly and closely side by side, like the leaves of a book. As the leaf grows the leaflets, still folded, move a little one from the other; at the same time their edges part, they begin to open out after the fashion of the cherry, and soon the whole compound leaf is extended. In the shamrock, again, each of the three leaflets is folded, and the three lie one exactly on top of the other. Then at the call of the spring they shuffle a little apart and proceed to lay themselves in position before they open. It is a dainty proceeding, as the photograph clearly shows.



The tender protective touch in the Tulip.

The star-like leaf of the lupin presents a variation of this method. Here each ray of the star begins life folded lengthwise, and all the rays stand erect, their faces inwards, like a ring of children closed up together. Then the ring backs out a little—the faces still inwards—but slits appear between the edges through which the darker green of the leaf-face can be seen. Finally the rays are laid right back so



The Fern alone is coiled from apex to base, and not from side to side.

The simplicity of the Cherry leaf. It is folded in half to begin with, and just opens like a book.

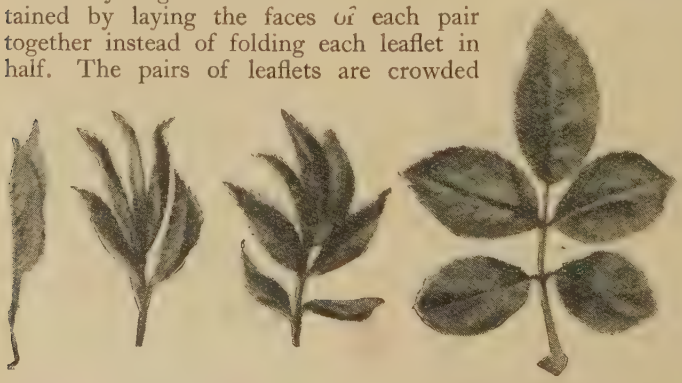
together for warmth at the outset; then as the stalk lengthens, carrying the pairs farther and farther apart, the leaflets lift themselves one from the other and, passing through a complete right angle, they stretch out like so many arms to right and left of the midrib. The leaf of the beech is typical of another beautiful method of pleating—the way of the fan. It has a stiff midrib and a number of parallel ribs running from the midrib to the edge of the leaf. These parallel veins are analogous to the sticks of a fan while the delicate green leaf tissue is no whit behind the beautiful brocades and satins of fashion. At the beginning these ribs, like the sticks in a closed fan, are pressed together, but as growth proceeds the leaf opens just as does a fan.

that now they are in a plane at right angles to their original position, and by this time the dark green face of each ray is fully exposed to the sunshine. It is a beautiful opening to the life of a beautiful leaf.

In the simple little leaf of the convolvulus there occurs a curious variation. It is folded in half at the outset, but from its extreme infancy it clasps the parent stem as a frightened child clutches at its mother's skirt. Not until it is quite a fair size does it let go its hold. The stem pictured on p. 157 shows this trick in its various stages.

How the leaf of the Vetch grows up. Note that the leaflets are not folded, but are laid together in pairs for protection.

In the vetch leaf—the big leaf that is cut up into so many pairs of leaflets—the same amount of protection for the young leaves is obtained by laying the faces of each pair together instead of folding each leaflet in half. The pairs of leaflets are crowded



The leaflets of the Rose, folded in half, lie together like the leaves of a book. Then they move apart, the stem lengthens, and the leaflets open as the Cherry leaf does.

In the leaf of the "lady's mantle," as might be expected in a plant with such a name, the pleats are on a bolder scale, but they still lie along the veins which radiate from the centre to the apex of the leaf.

In certain compound leaves such as those of the horse chestnut, each of the

The beautiful star-like leaf of the Lupin begins life with every ray folded in half and all raised and pressed together. This photograph shows the stages of development.

The tiny leaflets of the delicate Columbine leaf are, at first, closely packed, unfolded, together. They shake out as growth proceeds.

The Geranium leaf is crumpled up rather irregularly in infancy, but smooths out as it grows.

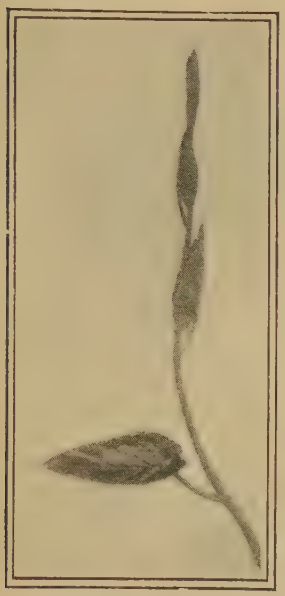
The leaf of the Beech opens like a fan.

leaflets is in fan-like pleats, while in the hairy leaf of the strawberry-leaved potentil there is quite an elaborate pleating and folding, for the three leaflets that make up the whole are both pleated and folded in half, and to make a further provision against cold and rain the leaves are hoary with down. The strawberry-leaved potentil leaves nothing to chance! But every leaf is not daintily folded or curled. In some cases, like children who have run wild, their methods of development are more uncouth. Thus the rather coarse geranium leaf is crumpled up inside the bud very irregularly, and the primula and the oak are instances of even worse untidiness; but these irregularities disappear as the days go by, and the leaves soon present the usual smooth surface common to leaves in general.

In the infant leaf of the Shamrock the three leaflets are neatly folded in half and placed exactly one on the other. Later they set themselves in position and open out.

It is not possible to chronicle here all the varied unfoldings that may happen among leaves; one must pass among them with the "seeing eye" in the bright

The unpleating of the leaf of the "Lady's Mantle."



The young leaves of the Convolvulus look a little like a monkey climbing up a stick. Each closely embraces the stem at the beginning of life, but loosens its hold and eventually breaks free when nearly grown up.

spring days, if one would learn their ways and enrich one's life with such new interest and knowledge. But there is yet one other leaf that cannot be left without notice, and that is the delicate columbine. Here there are many fragile little leaflets which start life collected into a very tiny bunch, not folded or rolled in any way but simply laid one on the other. As they grow, ruffled by the spring wind, they shake out into a rosette which increases in size and then begins to differentiate into stalks and suggestions of separate leaves. Finally we have the complicated and charming full-blown leaf. It rather reminds us of the well-known conjurer's trick—taking a piece of coloured paper, shaking it up and down, and finally producing from it all manner of ribbons and flags.

A few leaves do not truckle to atmospheric conditions, just as some men glory in not wearing an overcoat in the winter. Such leaves emerge straight out of the ground or straight from the branches, trusting to a thick skin, and are merely adult leaves in miniature, attaining by degrees their full size. Thus the leaf of the ivy is, at its very beginning, simply the tiniest possible replica of a full-grown leaf, and so are the leaves of the box and the yew, the latter emerging as a tiny green needle which simply increases in length and darkens. The leaves of the daffodil start from the bulb enclosed in a scaly jacket, which is, no doubt, some protection for their most tender days, but they soon outstrip it and grow up sturdy, unfolded and straight, without any finesse, though they mutually shelter one another by being bunched together. In rosette plants, too, the baby leaves are not usually folded or rolled, for, coming always in the centre, they are protected by the surrounding rings of their fellows. But these leaves are in the minority, the majority are either rolled or folded or crumpled up in their infancy, and it is only as they become able to face the buffetings of the capricious spring wind that Mother Nature frees them from the restrictions that she lays on them for their own protection. Further, the leaves here described are but types, and there are myriads more to be found in every hedgerow and meadow, all acting on the same lines as one or other of these cited.

The leaf of the common Strawberry-leaved Potentil takes great precautions. It is both folded and pleated, and covered with down.

*Photo: Thomas Ball.*

The open cup-shaped nest of fine twigs of the Song Thrush marks an advance upon the mere platform of sticks. Inside its nest this songster daubs mud and so produces a cup of hard clay.

# 7.—THE NESTING HABITS OF BRITISH BIRDS

By A. LANDSBOROUGH THOMSON, O.B.E., D.Sc.

IT is probable that the earliest birds were arboreal, although many of those of to-day have found haunts other than the woodlands, and on this supposition the first situation in which eggs were usually laid was almost certainly a hole in a tree-trunk or a mere hollow in the fork of a branch. From this primitive laying-site to the highly specialized nests of some present-day birds represents a long step in the evolution of nesting habits ; but even among British birds alone, we can readily find examples to illustrate intermediate stages, for the extent to which the habit has been developed varies greatly from one kind of bird to another. In like manner we can find examples of all sorts of nests, from the almost non-existent to the relatively complex, among those of our birds which do not live among trees and bushes.

The supposedly primitive habit of laying in a natural hole in a tree-trunk is still adhered to by a number of birds, including such dissimilar types as the titmice and the owls, and there are degrees of difference in the extent to which the natural site is improved upon by further excavation or by the addition of some lining material. The supply of ready-made sites of this kind is obviously limited, and thus it is not surprising to find that some birds have carried the habit a stage further and have learnt

*Photo: J. T. Newman.*

The supposedly primitive habit of laying in a natural hole in a tree-trunk is carried a stage further by the Green Woodpecker, which makes a nesting hole for itself. It is the outstanding example of this development in Britain.

to make nesting holes for themselves. Of this the green woodpecker is the outstanding example in Great Britain; with its strong beak, also used in the search for food below the bark, it is able to hew for itself a safe hiding-place for its eggs and young, and a tell-tale collection of fresh chips at the foot of a tree will often give evidence as to the scene of its labours.

Other arboreal birds create sites for their eggs not by excavation but by external construction. The simplest type of nest of this description is the shapeless platform of twigs which is built by the wood-pigeon, and in this case the structure is sometimes so slight that the two white eggs can be seen through it from below. Some of the birds of prey also build nests of this kind, although of rather heavier material. A golden eagle nesting in a tree, for instance, will build an enormous platform of branches, and may add to it year after year until the whole may fall to the ground by reason of its weight.

An advance on the mere platform of sticks or twigs is shown by those birds which make some attempt at shaping the nest so that it provides a safe and comfortable central hollow for the eggs and the young. Of this the rook is a good example, making a well-shaped nest out of much the same building material as that used by the wood-pigeon. A further advance is shown by many of the small song-birds of our woodlands and gardens, which use finer materials and make more carefully constructed cup-shaped nests among the trees or bushes. Very small twigs, roots and grasses are commonly used, and these are woven with great skill into a nest of much perfection. To this is frequently added a lining of still more delicate material, of feathers perhaps, or of hair or wool or of small fibres, while the song thrush daubs the inside of its nest with mud, and so produces a cup of hard clay.

One further stage is still possible, and that is the complete covering over of the nest with a domed roof so that a snug chamber is made which can be entered only by a small opening in one side. No better example of

*Photo: J. T. Newman.*

The shapeless platform of twigs which the Wood-pigeon builds is the simplest type of arboreal nest of external construction. The nest here shown contains a chick one day old.

this can be found than the beautiful round nest of the long-tailed tit, with its warm lining of almost innumerable feathers industriously gathered by the builders.

There is just one final phase of the tree-nesting habit which we should notice before turning our attention to birds which have other haunts. Some birds habitually use the old nests of other species, with or without some slight efforts of their own at repair or improvement. The kestrel, for instance, will use the former nest of a crow. In some cases of this kind, moreover, it is not always a bird's-nest which is used, for a squirrel's drey is on occasion put to the same purpose.

*Photo: J. T. Newman.*

The nest of the Blackbird provides another example of the open cup-shaped, twig-built type. Unlike the Thrush, the Blackbird never adds a mud lining.

So much for the birds that nest in trees or bushes, but what of those which inhabit the fields and moorlands, the ponds and marshes, the river-banks and the sea-shore? Here again we may begin with those species which nest in holes, and they are many and various. In some parts of the country which are not well wooded the stock-dove, so named from its habit of nesting in a hole in the "stock" of an old tree, will lay its eggs some distance down a rabbit-burrow on the open moor or among the sand dunes near the coast; thus it serves to link together in our minds the hole-nesting birds of the woodlands and of the open country.

Another bird which utilizes rabbit-burrows among the sand dunes is the sheld-duck, and in this instance the birds may go from fifteen to twenty feet into the burrow, and the eggs are there laid on a soft bed of down plucked from the duck's breast. Still another example of a burrow-nester is that comical bird the puffin, but the rabbit-holes which it makes use of are those on some steep grassy cliff sloping to the sea. If necessary the puffin can burrow for itself with its strong beak and claws, but it is ever ready to profit by the rabbit's efforts, and does not scruple to eject the rightful owner by force of arms if he should still be in occupation. Puffins are gregarious birds at all times, and they are often to be found nesting together in great numbers — on Lundy Island in the Bristol Channel, say, or on the Scottish coast — a whole slope being honey-combed with the burrows which they have made or seized. Still other burrow-nesters of the sea-coast are the petrels of various species.

The kingfisher, most brilliant of our native birds, is a burrower of the river banks, and its nest is well out of reach in a dark chamber at the end of a tunnel a few feet long. The nest itself is in sad contrast to the beauty of the birds and to the gaudy plumage which even the newly fledged young display, for it consists of a nauseous bed of disgorged fish-bones and other refuse. Another bird which tunnels into the soft sand or soil of a river-side bank, or indeed in a similar situation elsewhere, is the sand-

martin, and in this case many pairs usually burrow close together and constitute a colony.

Of birds which are not burrowers but which often make use of holes and crevices in banks or walls, the wren will serve as an example. Unlike the other birds which we have just considered, however, the wren builds an elaborate domed nest, completely covered in except for a small opening in the side.

Leaving the birds which nest in holes and burrows, we have next to notice the large number of species which nest on the ground, either altogether in the open or among the herbage and undergrowth. Some of these, like the skylark and the meadow-pipit, build quite good nests, carefully concealed. Others again are content with a mere hollow scraped in the ground, sometimes with a lining of dry grass or the like and sometimes without. Among these ground-nesters are game-birds such as the partridge, plovers such as the lapwing, water-fowl such as the ducks, sea-birds like the terns, and very many others; there are still others which usually prefer less accessible sites, but will nest on the ground in regions where these are not to be found.

*Photo: Henry Irving.*

The nest of the Long-tailed Tit illustrates a further advance on the cup-shaped type. A domed roof is made so that a snug chamber, entered only by a small opening on one side, is secured.

*Photo: Stanley Crook.*

The Sand-Martin at its nesting hole exemplifies the burrowing habit of many birds which haunt the open country, the river-banks and the seashore.

From the open fields and moorlands to the fens and marshes is an easy step. Some birds, like the grebes, build floating nests actually on the water, while others, like the moorhen and the coot, build nests among the reeds growing in the shallows. Others again, like the black-headed gull, prefer to have a patch of ground as a foundation, although it may well be ground far too treacherous to the gulls. Some birds, like the rock-dove, the species from which all our domestic breeds of pigeon are derived, prefer ledges not on the open cliff but in caves ; others again, like the house-martin, are independent of ledges and can build their nests against the vertical rock face. Inland cliffs in hill regions are also resorted to by a small number of species, examples being the

*Photo: T. M. Blackman.*

The Wren's nest provides an example of the use of holes and crevices in banks or walls as distinct from the burrowing habit. Unlike the burrowing birds, the Wren builds an elaborate domed nest, completely covered in except for a small opening in the side.

bear the weight of a man or of any large animal. Nests built in these damp situations are, as one would expect, usually rather bulky structures and are made of rushes, dry grass, and similar materials. Other water-fowl lay their eggs on firm ground but within easy reach of the water, as is common among the ducks, while a few, like the heron, build their nests in trees.

There are also birds which nest or lay their eggs on the ground, but do so in less accessible places than the open fields or moors. They choose the ledges of steep coastal cliffs, as do the guillemot, the razorbill, the kittiwake, the gannet and others, or the rocks at the foot of these or on small islands, as do the cormorant and some of golden eagle, the kestrel, and the jackdaw, and some cliff birds will nest either on mountain or maritime cliffs as circumstances may dictate. The nests built in these situations are frequently of large size, but rather indeterminate shape ; they may be made of seaweed as in the case of the cormorant, of dry grass as in the case of the herring gull, of sticks as in the case of the golden eagle, and so on. On the other hand, there are birds like the guillemot and the razorbill which lay their eggs on the bare rock without the slightest attempt at a nest.

From birds which nest on cliffs we may turn to birds which nest upon human habitations, and the transition is quite natural. The habit of nesting upon build-

*Photo: Henry Irving.*

The well-made nest of the Skylark belongs to the class of carefully concealed nests found on the ground, either in the open or among herbage and undergrowth.

ings is very obviously a recent one—recent, that is to say, as we count time in thinking of evolution. It follows, therefore, that these artificial structures probably present in some measure the counterparts of the natural nesting sites which were used before the days when man built houses. The principal birds which nest on buildings are the sparrow, the swallow, the house-martin, the starling, the jackdaw and the swift; if we were considering other European countries than our own we should certainly add the stork. Of these, perhaps the most constant are the swallow and the swift, both of which are only very occasionally found nesting elsewhere.

Although we have been taking various birds as examples of builders of particular types of nests in particular kinds of sites, it should be remembered that there is often a good deal of variety in the habits of a species. The choice of a nesting site is necessarily governed to some extent by local conditions, and although some birds may be altogether absent from unsuitable districts, others show considerable capacity for adapting themselves to different circumstances. We have noticed, for example, that the stock-dove chooses holes in the stumps of old trees in wooded districts, but that elsewhere it is content with rabbit-burrows. Similarly, the golden eagle will make its nest either in a tall tree or on a ledge of a mountain cliff, and the house-martin is equally satisfied with the wall of a house or with a natural rock face. The cormorant also is an interesting example in this respect; in Great Britain it ordinarily nests on rocks on the sea-coast, but in Ireland it is also common on inland waters, and there nests in trees.

Many exceptional situations are chosen from time to time by individual birds, of course, and we constantly hear of birds nesting in letter-boxes, on the axles of carts, and so on. It must be remembered, however, that what may seem a quaint situation from the human point of view, may be quite a natural one for the bird, the artificial

*Photo: T. M. Blackman.*

The Meadow Pipit is another of the ground-nesting birds. This nest contained a Cuckoo's egg and four eggs of the foster-parent.

structure presenting to the nest-builders just the conditions which they seek.

The character of the nest naturally depends in some degree upon the nature of the chosen site in the particular case, and also, of course, upon the kind of building material which is readily available in the locality. These factors bring about many variations in the nests of some birds, and at other times there are differences which seem to be quite fortuitous. A common tern will sometimes lay its eggs in a bare scrape in the sand, and sometimes it will first add quite a bulky lining of bent-grass or like material; it has been said that the amount of lining may depend upon the dampness of the ground, but on the other hand the two types of nest may be found side by side on the same patch of sand.

In spite of a good deal of variation, whether due to circumstances or apparently fortuitous, there is also a high degree of constancy—of building true to type. The thrush will practically never fail to add the lining of mud, and its cousin the blackbird will never think of making this addition. The wren will always make a domed nest, and the chaffinch will always make an open cup. Examples could be multiplied, but a few types to illustrate each point must here suffice.

In all the wide variety of the nesting sites chosen by different birds we can see one predominating principle, namely, the necessity of securing the safety of the eggs and the young, and also of the parent birds. The two main factors are concealment and inaccessibility. Both these are operative in the case of birds which lay their eggs in holes of any kind, and also where nests are built in thick bushes and the like. Inaccessibility is the main factor in the case of birds which nest in tall trees or on steep cliffs or high buildings, while the birds which lay their eggs on the ground necessarily depend entirely upon concealment—either that of the herbage and undergrowth or that which the natural "camouflage" of egg-shells and plumage bestows. The nest itself is less for safety from enemies than for safety from accident and for warmth and comfort.

The evolution of nesting habits is thus a history of endeavour towards the better

*Photo: T. M. Blackman.*

The Lapwing furnishes an example of the birds which are content with a mere hollow, sometimes lined with dry grass and the like, and sometimes without lining of any kind.

*Photo: G. C. S. Ingram.*

**NEST OF THE GREAT CRESTED GREBE.**

The nest is a bulky mass of vegetation floating upon the water, screened by the surrounding reeds.

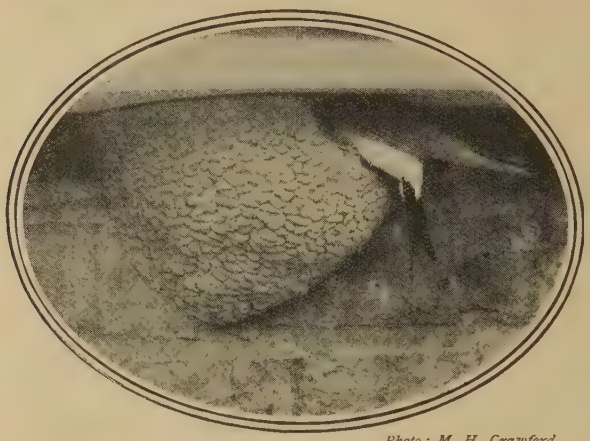


*Photo: M. H. Crawford.*

The House-martin's nest site upon a building is in some measure the counterpart of the natural nesting site upon a cliff-face used before the days when man built houses, and still frequently resorted to.

fulfilment of these objects, an endeavour which has been conditioned by the necessity for exploiting every possible kind of site as others have become overcrowded, and of adapting the domestic arrangements to the circumstances of new types of country. Thus we can imagine that development has followed two main lines from the time when the original birds were, as we suppose, exclusively arboreal and content to lay their eggs in natural holes in the trunks of trees. On the one hand, some birds have remained arboreal and have overcome the scarcity of natural holes by acquiring the habit of excavating for themselves or by evolving the art of external construction — the simple platform, the open cup, the completed dome. On the other hand, many birds have altogether abandoned the woodlands in favour of the open country, the marshes, or the sea-coast, and these in their turn show a series of adaptations of a variety of kinds: some nest in natural holes or make burrows for themselves, some conceal their nests among the herbage, some nest in the open and depend upon protective coloration, while others trust to the inaccessibility of ledges on maritime or mountain cliffs or of situations surrounded by water or marshy ground. Man, of course, has in many cases upset the balance of nature either directly or by such indirect means as the cutting down of forests and the draining of marshes; in other cases his rôle has been beneficent, and the buildings which he has erected have afforded fresh scope for the nesting activities of not a few species.

The nesting habits of many individual species will be described elsewhere in these pages, and we need not now go beyond our main theme to discuss in more detail how these various nests are built. We may mention, merely, that in some cases the cock bird takes his full share of the work while in others he gives little help or none at all, and that some birds will never use the same nest twice while others will repair their old homes year after year.

*Photo: T. M. Blackman.*

The nest of the Pied Wagtail provides another example of a bird which builds a good nest in a carefully concealed spot.

Nest of the Coot among the reeds in the shallows.

Nest of the Wild Duck on firm ground, but near water.

*Photos: F. T. Newman.*

Moorhens hatching out in their loosely made nest among the pond reeds.

A furze-bush is a favourite nesting-site of the Linnet. Both parents take a share in tending the young.

# 8.—A CONFIDING LITTLE NEIGHBOUR—THE LINNET

By HENRY WILLFORD

With photographs by the Author

THERE must be few happy possessors of gardens, either in town or country, who have not been visited at some time or another by the linnet. It is an unobtrusive little songster, and flits quietly about in the bushes, often unnoticed and unrecognized, yet it is very fairly distributed all over the British Isles. It is not, however, particularly fond of the rigours of the north. In the north of Scotland linnets are very rarely seen, and the Shetlands they do not visit at all. In those cold districts its place is taken by a near relative, the mountain linnet, or twite.

With the awakening of the year, when spring once more reclothes the hedges, the linnets begin their courting, and it is then that the song of the male is at its best. Any day he may be heard from his perch upon a tree-top—in copse or garden or by the roadside—trilling his low sweet song of love, and mingling his notes in the general chorus.

The nesting site varies a good deal. Often it is found in the fastness of a furze-bush at no great height from the ground. At other times it is in wayside hedges, or even in our gardens. In my own garden, year after year, nests have been built in apple-trees, or in laurel bushes bordering the lawn, and it is not unusual to find three or four pairs nesting quite close together.

Though so small a bird, and so neat in personal appearance, the nest is bulky and untidy-looking. Inside, however, it is warm and comfortable, the first foundation of grass, moss and feathers being snugly lined with wool and hair. As a rule care is taken to protect the nest from the direct

HEN LINNET PREPARING TO BROOD.

As soon as one brood is hatched the undaunted little mother sets to and lays another clutch.

Hen Linnet feeding her young. Small seeds, especially those of our commonest weeds, form the favourite diet, and it is served to the chicks in half-digested form.

rays of the sun, though I have found some quite exposed. When all is ready, six little eggs are laid therein, bluish-white with red-brown spots massed at the larger end. In colour and size they are very like the eggs of several other birds, such as the greenfinch, goldfinch and twite. So close is the resemblance that it is necessary to watch the parent birds actually at the nest before one can be really certain to whom they belong.

The linnet is a prolific breeder, for as soon as one brood is hatched, and the young ones fledged and flown, the undaunted little mother sets to and lays another clutch, and often three or four broods may be reared in the season.

Linnets belong to the finch family—one of the largest families of song-birds, and one which includes such widely different species as the canary and the house-sparrow. The chief characteristic of the family is the short, stout, conical bill. This is less pronounced, however, in the linnet than in some others such as the bullfinch or goldfinch. All the finches are lively and active little birds, and the majority are sociable and friendly, living, as the linnet does, contentedly in the neighbourhood of human dwellings and gardens. The food of the tribe consists chiefly of seeds, though insects, fruit and buds are eaten by some. The linnet seems particularly fond of small seeds, especially those of our commonest weeds, and they should therefore be in high favour with farmers. I have never seen them bring live food to their young, but on arriving at the nest they regurgitate what looks like a half-digested mass of small seeds and possibly insects. The cock bird is a hard-working parent, for the hen, as she broods her chicks, seems to expect food to be brought to her as well. Sometimes, on hearing the twitter that announces her mate's arrival, she will uncover her young and behave just as they do when first fledged. Agitating her wings, she opens and shuts her mouth as if appealing for food, and not until the young are satisfied and the remainder bestowed upon her will she cease this curious display. She is a close sitter at all times, careful of her brood, and takes much pains to shelter them in heat or rain, especially when the nest is in an exposed position.

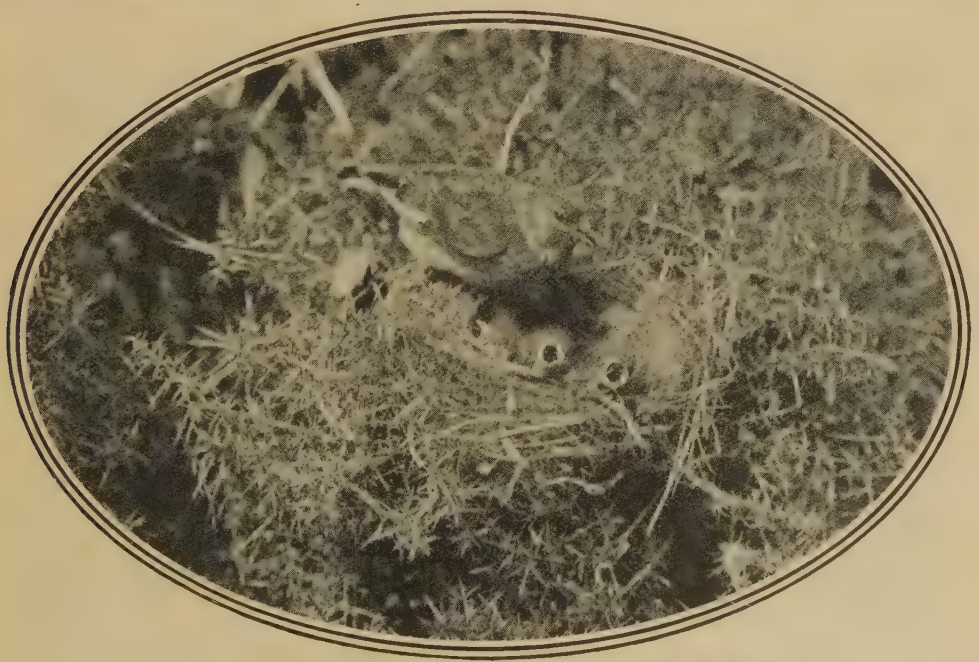
Linnets are sociable birds, and in the winter months are very commonly seen in

small flocks, flying quickly overhead with spasmodic, dart-like flight, easily recognized by their cheerful twittering. In colour, male and female are much alike, being reddish-brown streaked with black, and wing and tail feathers black, with white on the outer margins ; the only difference between the sexes is the smaller size of the female, and the absence, in her case, of crimson breast and forehead.

Although some are with us all the year round, a certain number arrive from the Continent during the autumn, whilst others that may have bred in our gardens spend their winter farther south. They are friendly, confiding little birds, and unfortunately this trait often leads to tragedy, for numbers are captured and imprisoned in cages by those who can enjoy nothing but what they themselves possess. In Scotland and the north of England singing contests even take place amongst these poor captives, for sing they will even in prison, and it is marvellous to hear sometimes how long the voice can carry on without a break. The only sign of despondency is in loss of colour, for in captivity the rich crimson of the male fades completely from his breast.

In a wild state the birds lose much of this crimson colouring from their breasts during the winter months, but it is always regained during the breeding season. In the case of their captive fellows, however, whether they be kept in a cage or large outdoor aviary, this gay colouring is never recovered after the first moult in captivity. The reason for this seems somewhat obscure, but it occurred amongst a few pairs I kept years ago in an aviary which covered about half an acre. These birds were in perfect health and successfully reared broods of young, but the young never attained this breast colour, and the adults never regained it.

It is generally supposed that in its wild state an injured bird or beast has little chance to recover, and in the struggle for existence must perforce go under. But an instance of complete recovery came under my notice once on a furze-covered common, when I was in hiding at a nest of young linnets. Several times the cock bird had arrived with food for the chicks, but for some time I never saw the hen. When at last she put in an appearance, I saw that one eye was missing, and



The cock Linnet is a hard-worked parent, for the brooding hen seems to expect food from him, while he also takes turn in feeding the nestlings.

the whole of one side of her head bare of feathers. In all other respects she was sound and whole. It is conceivable, of course, that she might have been born in this condition, but it is more likely that the injury was due to fighting, and that she had somehow managed to evade those enemies that are ever ready to take advantage of the helpless. Linnets are not, however, of an aggressive nature ; they are unassuming little birds, and usually live on the best of terms with their neighbours and each other.

When at last they leave their nesting haunts about our gardens and depart to the fields, it is no great distance they have gone, and perhaps some fine evening in late autumn or early winter we may wander afield ourselves and come across that same little community whose notes had so delighted us in the spring—now flitting about the stubbles and feasting on the autumn profusion of wild seeds.

Linnets are to be found throughout practically the whole of Europe, and in many parts of Asia. During migration they regularly visit north-western Africa. In India their place is taken by the rose finches, which may be called first cousins ; they are very similar in habits and appearance to the linnet, though much larger.

Fortunately we find the linnet an easy bird to watch at nesting time, for it is not lightly scared or driven to desert its eggs when once incubation has begun. The situation of the nest, too, makes concealment of the camera and the operator easy, for here we have to hand plenty of material with which to cover our hide ; a few branches of furze being all that is needed. Both parents and young may be described as of a particularly " busy " disposition from hatching time onwards, and the cycle of events from day to day form one continuous " peep-show " filled to the brim with interest.

Another advantage the linnet offers to the " camera man " is its steadiness, for on arriving at the edge of the nest it usually remains still for a moment or two, and never indulges in the pendulum-like movements of head and tail so common to members of the chat family. In conclusion, therefore, I can thoroughly recommend the linnet as one of the easiest and most interesting subjects for the young enthusiast who wishes to try his hand for the first time at bird watching and photographing at close range.

The hen Linnet at the moment of regurgitating the food for the little ones. She does not appear to carry live food to the young.

The Cuckoo arrives at the Meadow Pipit's nest. Note that there is no trace of an egg in her beak or throat.

# 9.—THE MYSTERY OF THE CUCKOO

By EDGAR CHANCE, M.A., M.B.O.U.
*Author of "The Cuckoo's Secret"*

With Kinema-photographs by Edgar Chance and Capt. Oliver G. Pike

THE cuckoo (*Cuculus canorus*) is commonly and widely distributed in spring and summer throughout the British Isles, arriving about mid-April (in some years a few birds arrive at the end of March), and leaving during July and early August. The old birds leave earlier than the young; some of the latter may tarry until September and October, probably because they were not out of their foster-parents' nests until the end of July or mid-August. They migrate to the south of Africa, the young birds travelling without any parental guidance, directed by the wonderful, and to us wholly inexplicable, instinct which enables them at the age of three or four months to find their way to their warm winter quarters many hundreds of miles distant.

Reports of cuckoos being *heard* in England during winter may be dismissed, one and all, as fairy tales. Country boys can easily imitate the well-known note, some so cleverly that the practised ornithologist might well be deceived. Cuckoos reported as being *seen* in winter are probably nothing more than sparrow hawks or kestrels, which in shape and flight, when momentarily seen, closely resemble cuckoos. Again, a wood pigeon which might happen to be on view at the time a lad was voicing "cuckoo" would, by casual observers, be promptly dubbed a cuckoo.

If, however, it should happen that a genuine cuckoo is seen in winter, its presence is probably due to some slight accident which incapacitates it from any lengthy flight. The event is, however, abnormal, and

The Cuckoo turns to the Meadow Pipit's nest.

it is more than likely that nearly all such records, as well as those of cuckoos shot in winter, relate to some unfortunate birds that have escaped from captivity.

It is the male cuckoo that gives vent to the well-known song—if *cuckoo*, *cuckoo*, *cuckoo*, repeated many times can be called a song. The sound is a joyous one, particularly when heard on those warm, sunny days that are so welcome in the latter half of April.

The hen cuckoo has a peculiar bubbling note, slightly resembling the alarm cry of a blackbird, but more liquid and melodious. It is affirmed that both sexes utter both cries, which contention, however, during many years of close observation, I have not been able to confirm or uphold.

Remarkably little was known about the actual laying habits of cuckoos when I seriously took up the study in 1918; prior to that date I had been interested casually in the species, but in that year I determined to find out how and when and at what intervals the eggs were deposited in nests of the meadow pipit (*Anthus pratensis*). How this was accomplished is fully set out in my book, "The Cuckoo's Secret."

I discovered that eggs were deposited every forty-eight hours, and almost invariably during the afternoon. I also proved to the satisfaction of all ornithologists that cuckoos, parasitic on meadow pipits and other similar ground-building birds, sit on the nests of the fosters and lay their eggs in the ordinary manner. This interesting discovery was for the first time in history photographed and filmed under my instructions in 1921, and again even more successfully and convincingly by Messrs. Oliver G. Pike and H. M. Lomas, under my direction, in 1922, with the use of both ordinary and ultra-rapid Kinematographic cameras.

It was in 1920 that I actually learnt for the first time how to see an egg laid, after which I was able to forecast not only in which nests and on which days, but the approximate hour, the eggs of a certain cuckoo would be deposited, and to invite visitors and ornithological friends to witness and confirm

The Cuckoo looks into the Meadow Pipit's nest.

the event. I had heard of several cases prior to this in which a cuckoo had been seen to lay its egg, or rather to leave a nest in which was found a warm and newly-laid cuckoo's egg, but these were one and all pure accidents, and *not* the result of several seasons' study and countless hours spent in observation.

The method of laying in domed nests and in nests in small holes in trees, walls, crevices, etc., into which a cuckoo cannot possibly enter and sit, is still one of great controversy. I am now, however, of the most decided opinion—which I have held only since the spring of 1922—that in all cases the cuckoo will lay its egg directly in or *into* the nest of the bird chosen as fosterer.

When a cuckoo cannot sit on a nest, it is my opinion that she will cling to the herbage, tree, wall, etc., and adjust her cloaca to the entrance of the nest-hole in the same way as male birds often have to adjust themselves into awkward attitudes when fertilizing their mates.

To my mind this theory is more in accordance with Nature than the clumsy and unnatural, although generally alleged habit, of laying its egg first of all upon the ground, then swallowing it, and finally regurgitating it into a nest.

There are several recorded statements, some made by ornithologists of considerable repute, of a cuckoo having been seen to deposit an egg into a nest with its beak. It is not likely that such men would make statements in which they did not firmly believe; nevertheless, I consider that they have mistaken the actions of the cuckoo, perhaps because deposition by any other means than by the beak had seldom or never been contemplated. The rapidity, too, with which an egg can be laid had never been fully realized nor generally known prior to my investigations.

It is difficult to compute the average number of eggs laid, as individual birds vary from a very few up to as many as twenty-five in a season; such an exceptional and record number I obtained in 1922. Probably eight or nine would be a fair estimate for a general average, the number being influenced not only by the age of the bird, but by the supply of suitable nests, and also whether the individual be a "wandering" or "dominating" cuckoo.

The Cuckoo selects a Meadow Pipit's egg. (There were two in the nest.)

My theory of "dominating" cuckoos is now generally recognized by naturalists, and a few words on this subject may be of interest.

A female cuckoo that is probably stronger physically than others of her species in a particular stretch of country, will there dominate and rule, and will brook no rival. In this territory she will deposit her eggs, and woe betide any other female cuckoo caught in the attempt to do the same in her domain. Such a cuckoo will lay her

eggs in this territory only. This domination will continue year after year until she dies or is probably ousted by a stronger bird than herself, when she will become either a " wandering " bird or one that will lay two or three eggs in her favourite territory, slipping in to deposit them at the risk of a thrashing from the cuckoo which ousted her.

A " wandering " cuckoo may be described as one which is not strong enough to dominate any territory ; buffeted from pillar to post probably by stronger birds than herself, she will naturally not lay as many eggs as a " dominating " bird, inasmuch as she has not the same opportunities of observing and finding nests of the favourite dupes of her kind.

I also discovered a fact, which has since been confirmed by other ornithologists, that a cuckoo finds nests in which she intends to lay some five or six days in advance. She sits motionless and concealed in an advantageous observation post or look-out, such as a tall tree or shrub, whence she watches her dupes in the act of building.

As an illustration. A certain cuckoo finds a nest, say, on the 14th of May, in which she intends to lay an egg, say, on the 19th of May. (I consider that it takes about five days in most birds for an egg, after leaving the ovary, to become ready for laying). Now, between these two dates she lays two eggs, one on the 15th of May and the other on the 17th. About the 16th and 18th she also probably finds and decides upon nests which will receive eggs from her on the 21st and 23rd, and so on.

This process may be artificially encouraged and maybe continued for several weeks ; indeed, a particular cuckoo that I had under very close observation and study for five years in succession made but few mistakes, and rarely got muddled. I consider this a wonderful instinctive feat. A cuckoo will deposit her egg in a chosen nest, even if such nest has been deserted during the period between the finding of it by the cuckoo and the laying of her egg.

The Cuckoo steals a Meadow Pipit's egg, then places her body over the nest.

When ready to lay, the flight of the cuckoo to the chosen nest is one of considerable grace and beauty, and may be likened to the glide to earth of an aeroplane. The length of this gliding flight varies according to the distance of the observation post from the nest, and may be anything from 15 to 120 yards ; when approaching from the latter distance a few flaps of the wings are necessary.

After laying, she will fly rapidly from the nest, usually carrying in her beak a stolen egg, and after perching and eating the egg will frequently utter a joyous " bubbling " note, which is doubtless an indication to her mate or mates that her important task is completed. Does not an ordinary farmyard fowl cackle in similar circumstances ?

The Meadow Pipit is kept hard at work feeding her voracious youngster

For no sooner is one morsel swallowed than the Cuckoo cries out for more

*Photographs by T. M. Blackman*

**Next time she tries him with a white, gauzy-winged moth, and finds his back the most convenient alighting place**

*Photograph by T. M. Blackman*

And in order to reach into his gaping throat the little foster-mother must stand upon her monster's very head

*Photograph by T. M. Blackman*

Looking very pleased with her capture she offers a large green caterpillar

And in a few minutes follows it up with a crane-fly. But the Cuckoo merely cries "More!"

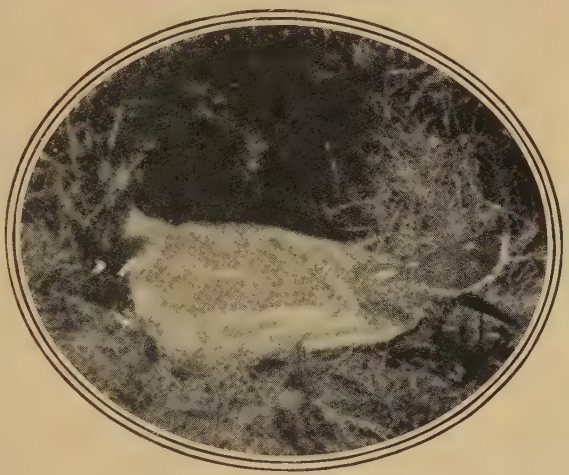
*Photographs by T. M. Blackman*

The number of eggs laid by a " dominating " cuckoo can be regulated by human agency, as I have proved. Such a cuckoo may have up to twenty or thirty eggs in her ovary ; the number of these to be laid will depend very largely on the supply of suitable nests of her favourite dupes, and if one can control these supplies, the number of eggs laid can to a very considerable extent be regulated. There is an erroneous belief that all the eggs in a bird's ovary must and will be laid. This is entirely wrong. Of course, once an egg is dehisced from the ovary it must be produced ; but, in my opinion, dehiscence can be regulated by female birds according to necessity.

To test this in practice, in the case of the cuckoo, one must have an ideal territory and suitable fosterers, of which the meadow pipit and the reed warbler are probably the best and most easily worked. Such a suitable locality I know of in Worcestershire, viz., a small common, on which in 1918 and 1919 almost every meadow pipit's nest found contained a cuckoo's egg, which invoked the idea—the more meadow pipits' nests in regular sequence, the more cuckoo's eggs.

In 1920 I was particularly anxious to obtain in this country a large number of eggs from one cuckoo. I had been told that the well-known German naturalist, Eugene Rey, once found in a season twenty eggs from a certain cuckoo. I therefore set out to beat this record. That season there were nine pairs of meadow pipits on the common on which I was carrying out my investigations, and by judiciously taking their nests, thus causing them to build and lay again, I provided sufficient accommodation for a particular cuckoo to induce her to lay a large number of eggs. This she did, obligingly laying as many as twenty-one eggs, thus beating by one what I thought was the German, and incidentally the world's, record. I afterwards found out that the most Rey obtained from one cuckoo in one season was seventeen eggs only. Apparently, it never occurred to him that the reason his collectors found long runs of eggs of certain cuckoos was due to their continually taking the eggs of the foster-birds ; in Dr. Rey's areas of investigation the fosters were principally the red-backed shrike, a prolific egg producer if repeatedly robbed, and thus providing a constant supply of nests which incited the cuckoos to continue conceiving and laying a considerable number of eggs.

In the ordinary course of events, and making no allowance for accidents, these nine pairs of meadow pipits on my cuckoo's territory would have hatched out and reared their first broods ; in early June their second nests would probably each have received an egg from the cuckoo,



The Cuckoo on the Meadow Pipit's nest—the actual moment of laying.

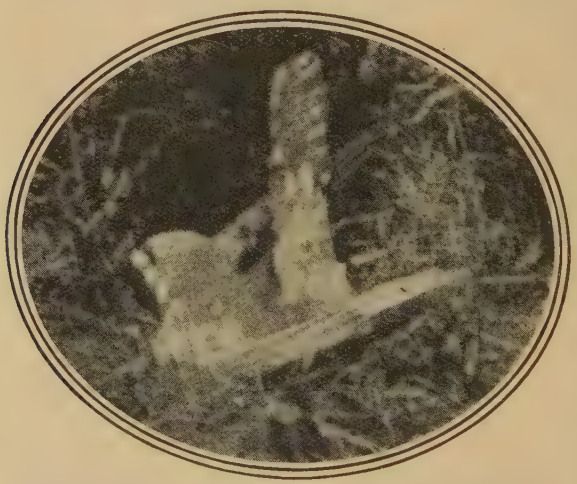
viz., nine eggs—and I maintain that is the approximate number the cuckoo would have produced. As the first nests of the meadow pipits at the end of April would have been too early for her, she would, probably, at any rate for the most part, await conception of her own eggs until she saw the meadow pipits building their second nests. She might, of course, have matured one or two eggs and laid them in the nests of tree pipits before she was able to victimize her favourite dupes, the meadow pipits. More probably the cuckoo would, by tampering with some of the incubated eggs laid by the meadow pipits before she was ready, have made some of these forsake their nests and build new ones for her own use.

A vast amount of time and hard work was necessary to find and keep track of all

the different pairs of meadow pipits and their nests, but in this I had the assistance of many willing friends.

In 1921 I adopted the same system, and correctly forecasted that if after the cuckoo had laid her fifteenth egg there were no more meadow pipits' nests available for her, she would cease laying. This I brought about by allowing all the meadow pipits after a certain date to incubate and hatch out their eggs, thus removing the cuckoo's incentive to continue to produce eggs.

In 1922, with more pairs of meadow pipits available, I decided there should be ample nests for the cuckoo throughout the season. By thorough and systematic methods of finding the nests and causing the fosters to re-build I was able to arrange that there should be a meadow pipit's nest in a suitable condition to receive an egg from the cuckoo every forty-eight hours. The cuckoo laid no fewer than twenty-five eggs, a new world's record, and six eggs more than have ever been recorded as laid by any other cuckoo in one season. Nothing will ever induce me to believe that this number would have been produced but for the fact that there was sufficient and regular incitement for the bird to do so.



After laying, the Cuckoo springs from the Meadow Pipit's nest, still holding in her beak the stolen egg.

Cuckoos can be recognized as returning to the same locality year after year, by their eggs, which in individual birds never vary ; it is extremely unlikely that two cuckoos will be found in one locality each laying exactly the same type of egg, just as a man would not be likely to find his "double" living next door!

The cuckoo, as is well known, lays an extremely small egg for a bird of its size ; it is scarcely as large as a skylark's egg, whereas a cuckoo is larger than a blackbird. The discovery of the fact that the cuckoo lays her egg in or into the nest, and does not lay at leisure at a distance and then carry the egg to the nest, as was previously surmised, assists us to discern the probable reason for the comparatively small size of the cuckoo's egg.

Laying in, or into, the nest the cuckoo is compelled to "extrude" the egg quickly, for the shorter the time she is at the nest-side the less likely is she to be disturbed in the act. Moreover, it must often happen that a cuckoo is frustrated in her initial attempt to lay in a nest owing to opposition on the part of the rightful owners or other interference. Ability to retain in suspense her egg in her oviduct would therefore be necessary to a cuckoo. These two characteristics —rapidity of actual discharge of her egg, and power of retention of egg even when ready to be laid—are in fact possessed by the cuckoo to a marked degree, and are probably only possible on account of the comparatively small size of the egg.

The belief that cuckoos can lay eggs *at will*, similar in colour to those of the fosterer, may be dismissed as entirely fantastic, but it seems to me only natural that evolution should tend to produce a frequent similarity in type and colour between the eggs of cuckoo and fosterer.

Records of blue cuckoos' eggs found in Great Britain are extremely rare, and are mostly, if not entirely, of very doubtful authenticity.

Evolution again, doubtless, is responsible for the fact that the same cuckoo will practically never lay two of her eggs in the same nest, for as often as she does so she is dissipating her productive powers, because a young cuckoo insists on being the sole occupant of the nest. When more than one cuckoo's egg is found in the same nest, the eggs are almost invariably the product of as many different cuckoos.

The Cuckoo flying away with the stolen egg after having laid her own in the Meadow Pipit's nest.

Various species of cuckoos and other similarly parasitic birds (e.g. cowbirds in America) are found all over the world. There are, however, some species of cuckoos that make a nest and rear their young in the usual way. As long ago as 1776 the illustrious Gilbert White, of Selborne, in his thirtieth letter to the Hon. Daines Barrington, states how he studied the theory of a French naturalist, M. Herissant, that a cuckoo was so constructed as to be incapable of incubating eggs, and why his theory could not be supported.

My observations all tend to the belief that, once the egg is laid, all interest on the part of the cuckoo in connexion with it and its fate vanishes, and once her last egg in a season has been laid, she leaves the locality a few days later. There is no proof that a subsequent visit by a cuckoo to a nest containing a cuckoo's egg is made by the same bird that deposited the egg.

A cuckoo's egg requires incubation, lasting from eleven to thirteen days, before it is hatched. When the young bird is about twenty-four or thirty-six hours old it starts on its murderous work of ejecting the young, or eggs, of the rightful owners, which happen to be its companions in the nest. It gets underneath them, and one by one works them on to its back between its outspread wings, then by desperate efforts clambers blindly backwards, with marvellous accuracy and tenacity, up the inside edge of the nest, and heaves overboard its helpless victims; the performance being repeated until the "little monster" has the nest to itself.

Should two young cuckoos be hatched in one nest the stronger eventually ejects the weaker. A few days later the instinct to eject is said to vanish.

It seems curious that the murderous

A Cuckoo standing by a Meadow Pipit's nest holding in her beak the egg which she had stolen.

*Photo: Richard Kearton, F.Z.S.*

**AN ADULT CUCKOO**

A female Cuckoo that is probably stronger physically than others of her species in a particular stretch of country, will there dominate and rule, and will brook no rival.

young cuckoo should be reared and fed by the foster-parents with such assiduous care and attention when their own young are lying dead or dying outside or below the nest. Why this unconcern, and why their untiring efforts to appease the enormous hunger of their unnatural and unsought "child," which rapidly becomes many times their own size?

A young cuckoo need never go hungry, even when able to fly and fend for itself; it has been said that it has only to cry for food, and it will be fed by various small birds. What the attraction is, nobody knows!

In my opinion a cuckoo will tend to victimize the same species as that to which its own foster-parents belonged.

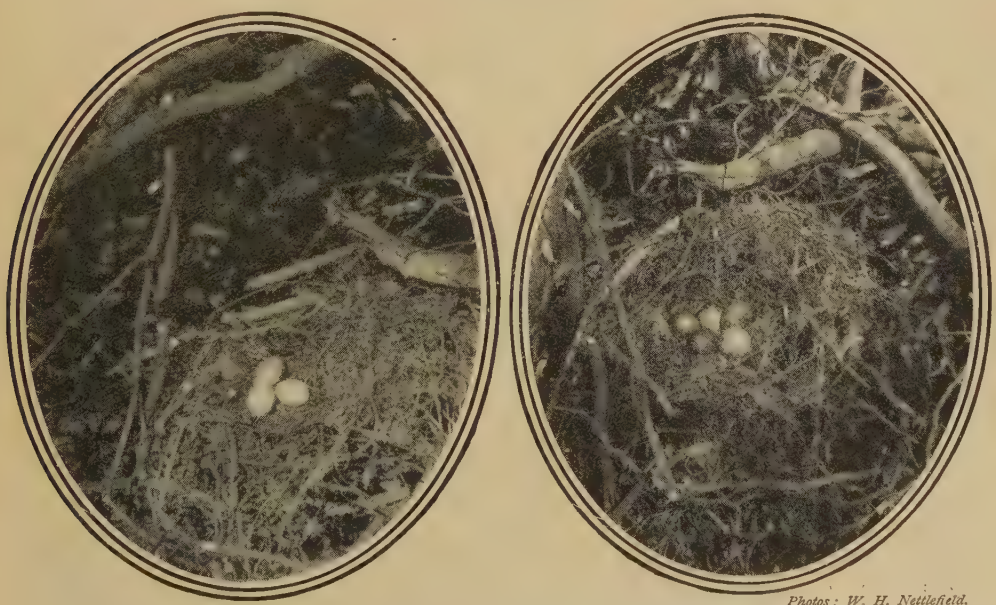
Some cuckoos at least are confirmed egg-robbers, and many a small bird loses its eggs owing to the gluttony of such. Caterpillars and other insects form the bulk of their food.

The six commonest fosters in this country are perhaps the meadow pipit, reed warbler, pied wagtail, hedge sparrow, robin and sedge warbler, but many other small birds are also victimized.

Whether cuckoos are polygamous, polyandrous or promiscuous is a very open question. I am inclined to the belief that they are, at least often, promiscuous. I should not, however, lightly dismiss the theory that some pair as normal birds. I shall, however, need many more years of study and observation before I can hope to advance any definite conclusions on this subject, and as the question is an exceedingly difficult one to prove with any degree of certainty, satisfactory progress in obtaining any real knowledge will almost assuredly be extremely slow. It is a subject which might well claim the close attention of more ornithologists.

The ancient belief that in the winter cuckoos change into hawks is still harboured by some, but that is by no means the only fallacy still prevalent concerning the cuckoo.

## The Curious History of a Nest



*Photos: W. H. Nettlefield.*

A photograph was taken of a Rook's nest (left) in the top of an elm standing some distance from a wood. Three eggs were seen. About a fortnight or so later the photographer returned to obtain, if possible, a picture of the young Rooks, but, instead, a Kestrel Hawk flew off. On climbing up, five Kestrel's eggs were found in the nest (right), and there was no sign of the Rooks!

# 4.—WASPS AND THEIR WAYS

By RAY PALMER, F.E.S.

PROBABLY no insects are more abused than wasps. Their bad deeds are obvious; whereas their good deeds, being less obvious, are generally overlooked. They play havoc with our ripe plums, pears and apples in the autumn; they help themselves to the jam, and make themselves a general nuisance at meal times whenever there is fruit about.

*Photo: Ray Palmer, F.E.S.*

Worker, queen, and male of the Common Wasp (natural size). As soon as the workers are sufficiently numerous, the queen devotes her time solely to egg-laying. The males appear late in the season.

Consequently, the hand of everyone is against them. Most people are really afraid of wasps; yet, individually, they are no more dangerous than the honey-bee, which stings only in defence of itself or its home.

Wasps visit our houses, no for the purpose of stinging human beings, as many people appear to imagine, but in quest of food. The wasp uses her sting as a weapon of defence only—man himself being almost invariably the offender—and even in self-defence she seldom stings unless her life is in immediate danger.

When the nest is threatened, however, things are vastly different. The workers then pour forth in hundreds, and each is ready to sting any living creature within reach. On such occasions they sting, not in defence of themselves, or their fellow-workers, or their queen, but in defence of the "brood," the thousands of cells containing eggs and every stage of helpless young wasps, from the just hatched larva to the mature pupa. This is the centre of attraction and unity. Should the queen die, the community will continue so long as the workers live and there be brood in the cells; if the nest be destroyed and but one comb left, the surviving wasps will faithfully continue to feed the remaining larvæ, although both queen and nest are no more.

Wasps resemble bees in some respects, but are notably different in others. They do not possess a long tongue like bees, and consequently the flowers they can visit for nectar are much more limited. Neither do they store honey; the papery nature and inverted position of their cells makes this impossible. A wasp's body is much less hairy than that of most bees—hairlessness in a bee being merely a sign of age and wear—and the wings are carried differently

*Photo: Ray Palmer, F.E.S.*

Various stages in the development of the Common Wasp, from the egg to the perfect insect.

when at rest. When a wasp alights and closes its wings, the fore-wings are folded along the middle, thus appearing only half their actual width, and looking like two narrow strips on either side of the body; whereas in the bee the wings are broad. Both bees and wasps belong to the order *Hymenoptera*, a term signifying "joined wings"—and is so applied because in flight the back wings are locked to the fore-wings by a series of minute hooklets.

The true wasps number about twenty-five British species; seven of these are known as "social" wasps, and the remainder as "solitary." The latter are smaller insects, and are so called because each female makes only a few earthen cells in a hole in a wall, post, or similar situation, and has no workers to assist in her labours. In each cell she lays an egg and places a supply of food, generally consisting of small caterpillars, stung so as to paralyze, but not to kill, them. The cell is then sealed up with mud; the young wasp grub, on hatching, devours the food provided, and completes its metamorphosis without further attention from the parent. How very different is this from the methods of the social species will be seen as we proceed.

*Photo: Ray Palmer, F.E.S.*

The Queen Wasp founds her colony single handed, acting as builder, forager and nurse until her daughters are old enough to take on the work.

*(Photograph greatly enlarged above life-size.)*

A wasps' nest, like a bee-hive, has often been compared to a city, and the inmates to citizens; but the comparison is not a true one in either case, and even less so in the case of the wasp.

The wasp community is really only a family, though a remarkably large one. The mother is the queen; the father was dead long before his first children were born; the daughters are the countless workers (undeveloped females), and the large females which will become "queens" next year; the sons are the males, which appear late in summer, though some of them may be the offspring of workers, and are therefore "grandsons" of the queen.

By far the most interesting individual in this community is the queen, and a comparison drawn between her and the queen honey-bee is certainly to the disadvantage of the latter.

When the queen bee starts a new community, she already has some thousands of attendants at hand ready to wait on her every need and do all the work of the hive. She is nothing more than an egg-laying machine, and even her one function is controlled by the workers.

The wasps' nest, on the other hand, is started by a solitary queen, awakened from her winter's sleep some warm day in early spring.

She flies along hedgerows and bank sides searching for a suitable locality. Presently she finds a mouse-hole, which she cautiously enters. Some distance inside, she proceeds to inspect the roof, until she finds a tree root or a large stone, which will support the nest. Retracing her steps, she emerges into the daylight once more, and for a moment or two hovers back and forth about the entrance in gradually widening curves, apparently making a careful survey of the locality, so that she can easily find it again. Then away she flies out of sight.

If we could examine her closely when she returns, we should see that her mouth was filled with a mass of greyish-looking material. This is wood fibre, which she has rasped with her powerful mandibles from an old rail or gate-post, or some dead plant stem, and chewed up into a sort of papier-maché. Down in the darkness of her tunnel she plasters this pulpy material upon the chosen support, and the foundation of the nest is laid. She works rapidly, and every time she leaves the hole carries a bit of earth in her jaws and drops it outside, thus gradually enlarging the burrow into a nest chamber.

She continues to collect fibrous material and make paper, adding layer upon layer

to that already applied. Soon she has completed a rather stout pillar, depending from the roof half an inch or more, at the end of which she constructs a bunch of shallow hexagonal cells, facing downwards, and then protects them by a kind of paper umbrella encircling the pillar above.

About half a dozen cells are formed, the queen depositing in each a small white egg, only for their honey, but for the flies and other insects which are attracted thither. A queen wasp with growing babies entirely dependent on her, wastes no time over her hunting. She pounces on the first insect she comes across; if it is a small caterpillar it succumbs quickly; if a large fly, there is a short struggle in mid-air, ending in the wasp biting off the wings and perhaps the

*Photo: A. Harold Bastin.*

The "Face" of a Wasp enormously enlarged and "touched up" to bring out details. When photographed, the original had crawled to the end of a broken twig.

one end of which is attached to the side of the cell by a sticky secretion. In about a week these eggs hatch into tiny white legless grubs, the queen meanwhile constructing further cells and laying more eggs.

As soon as the larvæ are hatched, however, her energies are entirely devoted to feeding and caring for them, in which she shows a maternal instinct quite unknown to the queen honey-bee.

The food she brings them is not, as might be expected, the nectar of flowers and sweet vegetable juices, on which the queen herself subsists; it is animal matter, mainly of an insect nature. The wasp visits flowers not head, and carrying the rest home, where it is chewed up and distributed amongst the hungry grubs.

As the larvæ grow, their queen-mother builds up the walls of the cells around them, until, in a fortnight's time, they are full grown and completely fill the cells. Until now they have been helpless babies, unable to do anything but eat the food put into their mouths; now they have to perform the one act of their larval lives.

Out of its mouth each grub produces a fine thread of sticky material, which hardens, on exposure, to a white substance resembling silk. With this it spins a cap, securely

covering the mouth of its cell. After a few days the larval skin is cast off and the pupa is revealed. The pupa, in its early stages, is a beautiful object. At first it is perfectly white, and every external organ of the insect is visible. It reminds one of nothing so much as a delicate ivory model of a wasp, in which all the limbs are folded so as to occupy the smallest possible space. The eyes soon begin to darken, and are followed by a gradual darkening of the whole body.

In about ten days' time the pupa has developed into a perfect wasp, which bites its way through the white capping which it spun when a grub, and emerges from the cell. At first it is very weak, damp and pale coloured; but the queen feeds it, not with animal matter this time, but with vegetable juices, and as the young wasp dries, it quickly becomes stronger and brighter in colour.

The workers which emerge first spend their time in helping their less advanced sisters to escape from their cells and in dispensing the food which the queen collects. After a few days they, too, go out and assist their mother in collecting food and material for the enlargement of the nest. The queen lays eggs in empty and newly formed cells as fast as they are ready, and the number of workers rapidly increases; but the queen still continues to collect food and to work at the nest. Later on, when there are about thirty workers, she ceases to go out, and, devoting her energies to egg-laying, leaves the work of the nest entirely to her daughters.

The nest now grows with increasing rapidity, the first comb or layer of cells being extended on all sides in a circular direction, until it is about four inches across. Then a second comb is started below it, supported by a number of paper pillars, which allow just enough room for the passage of the queen between the two combs. So the unceasing labour goes on, until the nest contains six or more layers of cells, hung one below the other. At the same time the chamber containing the nest is constantly being enlarged; the earth is carried up and thrown outside, while the loosened stones, which the wasps, of course, cannot carry, accumulate at the bottom.

*Photo: Ray Palmer, F.E.S.*

Nest of the Larger Common Wasp photographed in its natural position in a bank, and showing the shell-like pattern of the outer covering.

The umbrella-like roof, which the queen constructed to cover her first few cells, is enlarged and extended into a thick covering of many layers of paper, which completely envelops the nest, leaving only a small hole

*Photo: Ray Palmer, F.E.S.*

Nest of the Larger Common Wasp shown with the covering removed. It contains six combs, of which only five are visible in the illustration.

for an entrance. The paper made by the workers is of a much rougher texture than that originally made by the queen, and by careful search it is often possible to distinguish the latter at the apex of the nest.

The illustration on p. 185 shows a nest in its natural position in a bank, but in digging it out the cavity below was considerably enlarged. In this photograph the shell-like pattern of the outer covering is easily discernible.

The next illustration shows the interior of the nest with the covering removed. It contains six combs, the upper one being concealed in the photograph. It will be noticed that the lowest combs consist of larger cells than the others. This shows that the nest had attained its full size, for the large cells are those in which the young queens are reared.

There is no apparent difference between the eggs or larvæ which produce workers and those which produce queens, but the latter receive much more food than the worker larvæ, grow larger, and become perfectly developed females. The workers are small, undeveloped females, though some of them are capable of laying eggs. The males are reared in ordinary worker cells, which are raised a little to accommodate their extra length; they are produced from unfertilized eggs laid by the queen towards the end of the season, or from the eggs of fertile workers. The male can be identified by his longer antennæ and abdomen, and the absence of a sting. The sting is really the ovipositor, a female organ, not possessed by the male.

A comb from the centre of the nest is shown on p. 187. The interest of this is that it shows two successive broods, in the roughly circular formation always adopted. The oldest cells (i.e. those first made) are in the centre of the comb, and are the first to be filled · therefore when these cells contain wasps ready to emerge, those at the edge may contain young larvæ, or even eggs, of the same brood.

When the wasps leave the centre cells, these are cleaned out and repaired, and the queen lays eggs in them again as fast as they are ready. Thus a second brood follows close on the heels of the first, and a third on the heels of a second, each extending in an outward direction from the centre. As a rule, after the cells have been used three times in this way, they are discarded.

In the illustration the cells with white caps contain pupæ, the outer ones larvæ just pupated, and those on the inner edge, wasps nearly ready to emerge.

The cells with ragged white edges are those from which wasps have only recently emerged, and have not yet been cleaned up by the workers. On the inner edge of the white-capped cells are a number which appear empty, but most of them contain

eggs or young larvæ. The next illustration shows the details more clearly, and it will be noticed that the eggs are not placed on the base of the cell, but in the angle formed by two of the sides. Below the eggs the larvæ are seen, getting gradually larger towards the centre of the comb, where we again come to white-capped cells containing pupæ. The second illustration on p. 82 shows the various stages, as extracted from the cells.

We have already mentioned that there are seven British species of social wasps; these differ somewhat in habits, though (with the exception of the hornet) only slightly in appearance.

The common wasps that nest underground are of two species, distinguished by certain marks on the face. The two types of nests also are different.

The larger common wasp (*Vespa germanica*) is usually the most abundant species in the south. This wasp makes a nest of grey paper, with a shell-like or scale-like marking on the outer covering. The nests are sometimes very large and have been known to contain as many as fourteen combs, though seven or eight is the normal number.

The lesser common wasp (*Vespa vulgaris*) is closely allied to the previous species, and only very slightly smaller. The nest also is smaller as a rule, and has the same scale-like marking, but the paper is of a light brown colour, with white streaks, which sometimes render it quite a pretty object. The brown colouring is due to the fact that rotten wood is principally used, and the white streaks are often caused by ordinary (man-made) paper, which this wasp likes to use, when it can be obtained.

There is a third species which nests underground, but is far less common than the other two. This insect is known as the red wasp (*Vespa rufa*), because the first two segments of the abdomen above are adorned with orange or reddish blotches, which vary greatly in extent and colour. This is the smallest of the seven species, and the nest is a very fragile affair, of rather inferior workmanship. The nest-paper lacks the scale formation of the other ground wasps, and is applied in irregular but continuous layers of a soft grey tint with lighter markings.

The red wasp is particularly interesting because of another species which associates with it, living and breeding in its nest, on apparently amicable terms. This insect (*Vespa austriaca*) is often called the "cuckoo wasp," because its relations to the red wasp are very similar to those of the cuckoo and its foster-parents. The cuckoo wasp is similar in general appearance to the red wasp, and was at one time thought

*Photo: Ray Palmer, F.E.S.*

Comb from the nest showing two broods in their various stages. The white-capped cells contain pupæ; the outer ones larvæ just pupated; and those on the inner edge, wasps nearly ready to emerge. The cells with ragged white edges have not been cleaned up since the emergence of the young wasps.

to be only a variety of this species. It lacks the red colouring, however, and differs in the facial markings. The cuckoo wasp has no workers, only males and fully developed females being known. The workers are provided by its host, into whose nest the female enters for the purpose of laying her eggs. Whether she is met with antagonism from the red queen we do not know; but her children are eventually reared by the workers, who doubtless do not know but that they are of their own species.

The three remaining wasps make their nests above ground, but construct them on the same principle.

A wasps' nest always contains a variety of insect life besides the wasps themselves. They find a home therein, living either as parasites or welcome guests which act as scavengers. These insects, welcome or unwelcome, form an interesting study; but only a few words can be said about them here.

Numerous small white eggs may generally be found in the outer envelope of the nest. These are the eggs of an anthomyid fly, known as *Sphecolyma inanis*, which is about the size of a house fly, but orange all over except the head and a stripe on the thorax, which are dark brown. This fly makes her way down the tunnel to the nest, on the outside of which she lays her eggs. The maggots, on hatching, at once drop to the base of the cavity, where there is always an accumulation of excrement and other organic matter thrown out of the nest. On this they feed, and so unconsciously contribute to the well-being of the wasp community.

Several larger flies, of the genus *Volucella*, also live in their early stages in wasps' nests. The larvæ are broad and spiny, and act as scavengers in the interior of the nest. They feed apparently on the excrement of the wasp larvæ, which falls from the cells on to the top of the comb below. Other insects are actual parasites. One of them is the wasp ichneumon fly (*Sphecophaga vesparum*), whose larva lives in the interior of the wasp grub, which it completely destroys. The ichneumon larva then spins its own cocoon in the cell, which appears as though nearly filled with a pinkish-white cement.

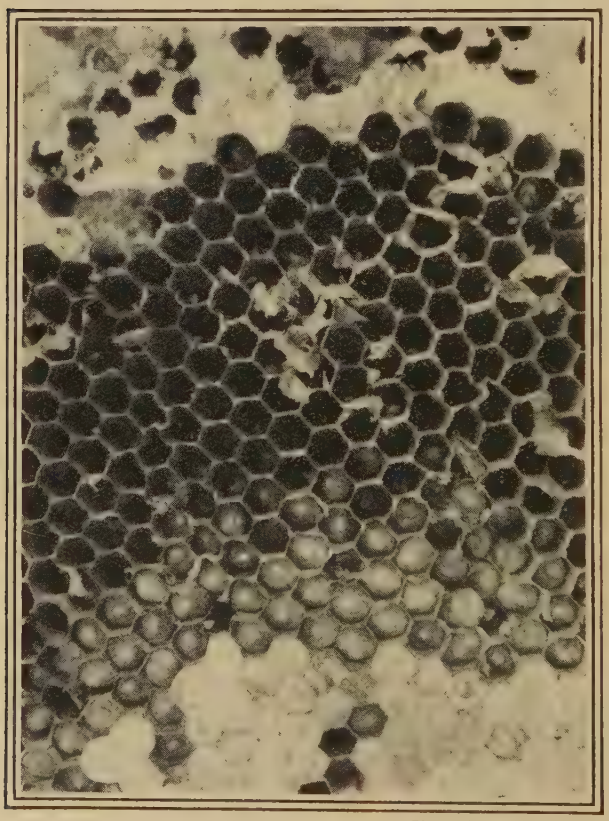
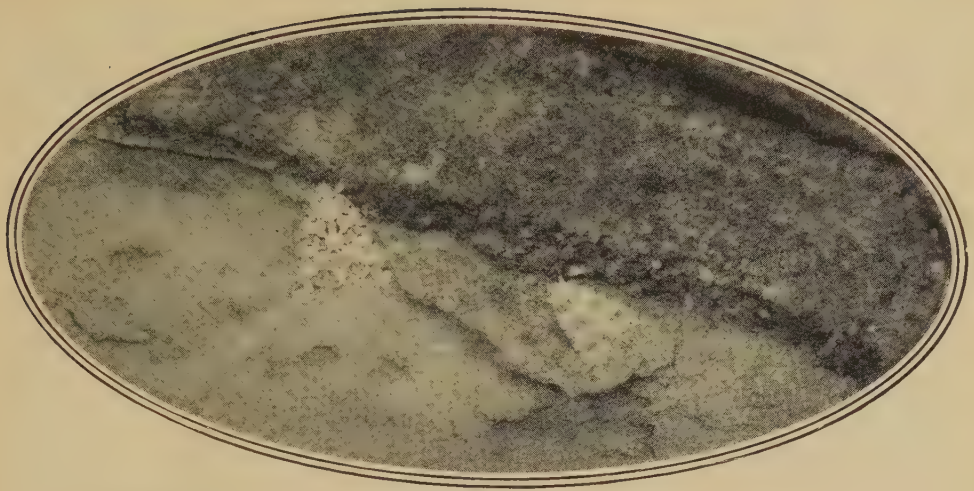


*Photo: Ray Palmer, F.E.S.*

Part of the comb of the Larger Common Wasps' nest enlarged to natural size, showing eggs, larvæ in various stages of development, capped cells containing pupæ, and empty cells from which wasps have emerged.

Another parasite is a beetle, known as *Metœcus paradoxus*. The larva is an internal parasite at first, but at a later stage it emerges from the still living wasp grub, and feeds upon it externally. The beetle larva allows its host to cap over the cell, then devours it entirely, and itself pupates in the cocoon provided by its victim.

The way this larva enters the nest is somewhat mysterious. Some authorities say that the female beetle lays eggs in the cells; by others it is thought that the newly hatched larva attaches itself to a wasp which is gathering material for "paper," and is thus conveyed to the nest.



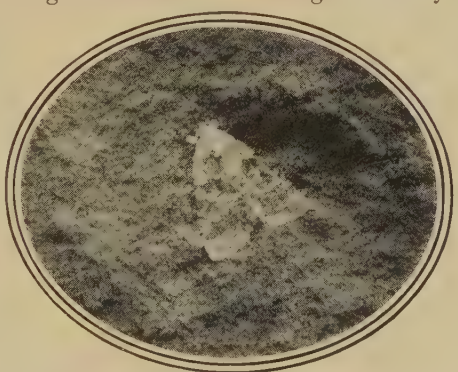
The Marbled Green Moth (*Bryophila muralis*), and the Marbled Beauty Moth (*Bryophila perla*) are alike in tastes and habits.

# 5.—IN SEARCH OF THE MARBLED MOTHS

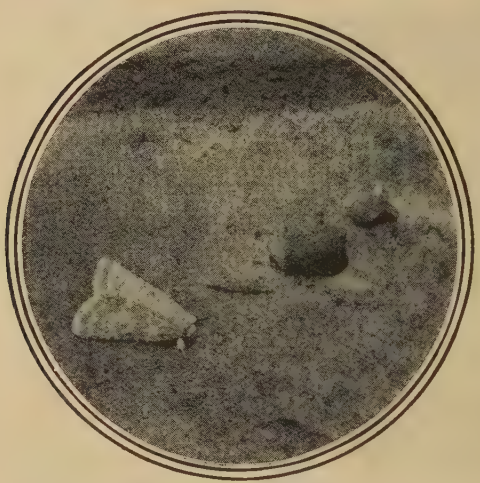
By C. W. COLTHRUP, Z.P.C.

With photographs by the Author

THE occupation of a naturalist offers much scope for misconstruction on the part of those busybodies of the public way who cannot bear to see a fellow-being depart from the recognized track. The marbled moths have been for many years my favourite study, and in the course of my searchings along the sea-fronts of various coastal resorts I have found myself not only the butt of every joker, but a source of much apprehension in the minds of the guardians of the law. To the onlooker unversed in the ways of these fascinating little insects, the sight of a man seriously and laboriously scrutinizing, and presently photographing, an apparently blank wall in a public thoroughfare may have its humorous aspect. For so well do these moths disappear into their surroundings that once, on a piece of wall about eighteen inches square on which I had located a marbled green moth (*Bryophila muralis*), I invited a suspicious policeman to inspect the object of my studies. This he magnanimously consented to do—somewhat in the way that one humours a child or a lunatic—but to his bewilderment, after searching carefully for close on ten minutes, he failed to discover any living thing whatever. His surprise when I pointed out the moth was delightful, and sufficiently compensated me for any annoyance I had suffered. The wings of the insect, mottled with every shade of green, pink, yellow,



So closely does the coloration of the Marbled Green Moth (var. *viridis*, Tutt) resemble the markings on an old lichen-covered wall that when resting on it by day it is practically invisible.



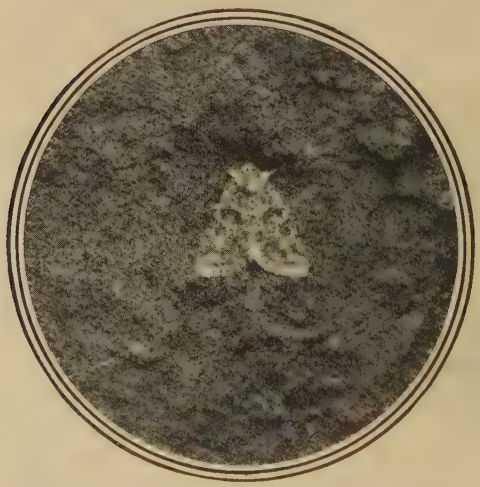
The Marbled Green Moth (var. *par*, Hübner) is sluggish, and spends most of its daylight existence in sleep.

brown, grey and black, so harmonized with the broken, lichen-spotted stone that for all practical purposes it was invisible to the inexperienced eye.

Both the marbled green moth and the marbled beauty (*B. perla*) are alike in tastes and habits. At night they fly to the flowers and honey-dew on which they feed, coming freely also to " sugar "—the moth-hunter's trap—or to light ; but by day they rest, motionless, on old lichen-covered walls. This is far the most interesting time to search for them. In attempting to secure them it will be found that the marbled beauty is more lively than its relative. It will leave its nook and attempt to escape, whereas the latter, when discovered, constantly changes its position as if loath to leave the wall. It seems to spend the greater part of its daylight existence in sleep. This sluggishness may perhaps account for its restricted range, for it is seldom found far from the coast. The farthest inland that I have discovered it is Lewes, Chichester and Barnham, in Sussex. I have also found it at Deal, Folkestone, Eastbourne, Brighton, Portslade, Worthing, Bognor, Gosport, all over the Isle of Wight, and Paignton in Devon ; it also occurs at Dawlish.

A variety (var. *impar*) of it is also taken at Cambridge, but it is an unsolved mystery how this sub-species became established so far inland.

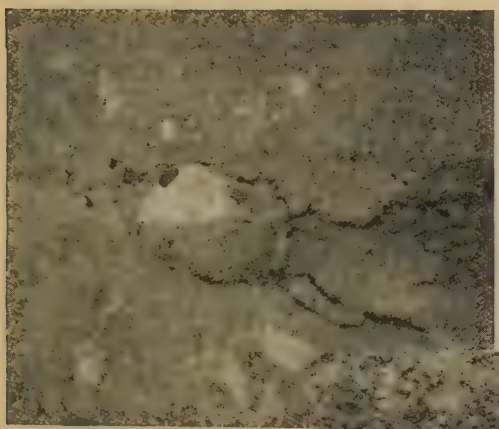
The wings of the Marbled Green Moth (*B. muralis*) are mottled with every shade of green, pink, yellow, brown, grey and black.



When discovered, the Marbled Green Moth (var. *suffusa*, Tutt) constantly changes its position.

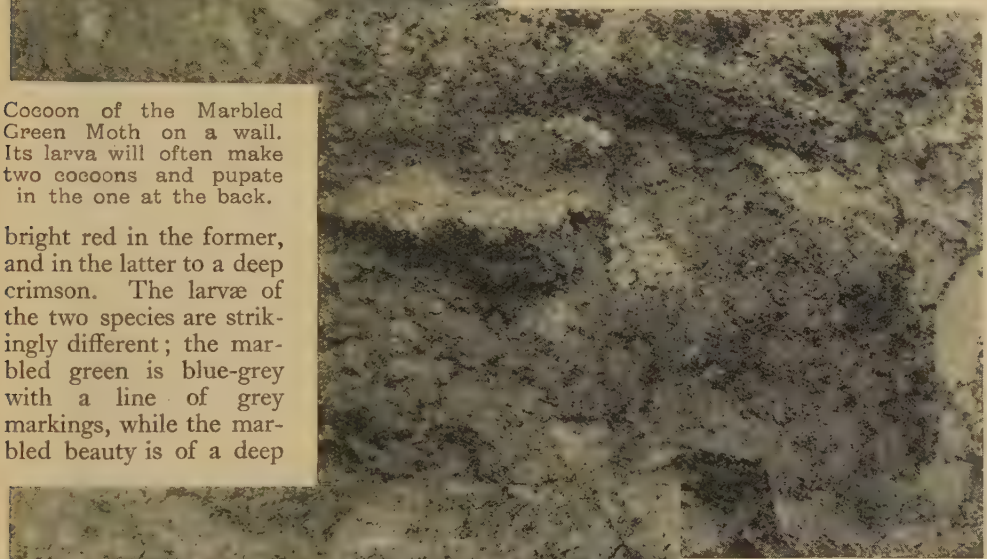
It is interesting to note that Newman in his " British Moths," has a record of specimens of *B. muralis* as occurring on the canal bridge in the Old Kent Road, London, S.E., but also notes that " he has not seen it for twenty-five years."

The eggs of both the marbled green and the marbled beauty are deposited on walls covered with minute vegetable growths and lichens. When first laid they are pale cream in colour, but on the second day pink markings appear, which change eventually to a

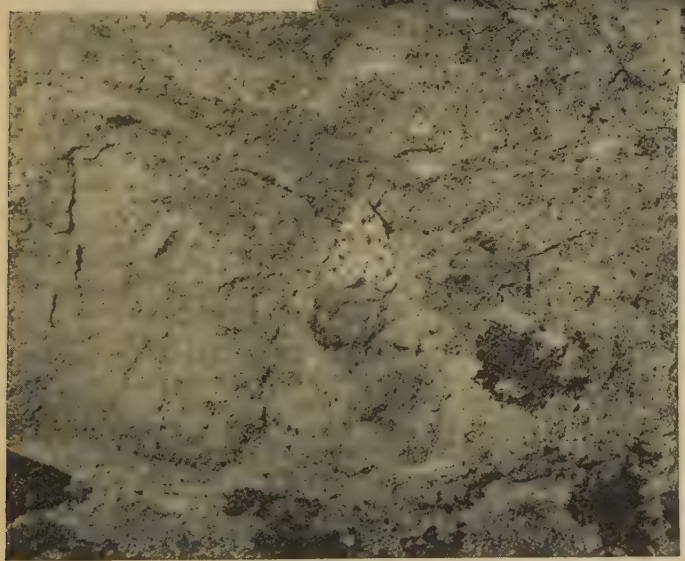


Cocoon of the Marbled Green Moth on a wall. Its larva will often make two cocoons and pupate in the one at the back.

bright red in the former, and in the latter to a deep crimson. The larvæ of the two species are strikingly different; the marbled green is blue-grey with a line of grey markings, while the marbled beauty is of a deep plum colour with orange triangles down the back. As soon as the larvæ are hatched they begin to feed on what vegetable matter they find on the lichen-covered stones, and at intervals of feeding return to rest in a little cocoon of their own spinning. As they increase in size, larger cocoons are made. When irritated they eject a fluid, green in the case of the one and brown in the other. Both larvæ can be found plentifully after a shower of rain, wandering about the walls and feeding in the day-time.



Another illustration of the Marbled Beauty Moth which lays its eggs on walls covered with minute vegetable growths and lichens.



The Marbled Beauty Moth (*B. perla*) is more lively than its relative; when discovered, it will leave its nook and attempt to escape.

The larva of the marbled green will often make two cocoons, and pupate in the one at the back. I have found these cocoons in all kinds of situations—in crevices in walls, in out-of-the-way corners under copings, on the ground in friable dust that has been blown into a corner, and under moss on the top of the walls. When working for pupæ I have found it very profitable to search some

wall that faces a street lamp, acting on the assumption that after a moth is tired of staring at a light, it will most probably alight on a wall close by and there lay its eggs.

The final cocoons of both species, in which they pupate, are much tougher than the hiding cocoons. When the larva is ready for its transformation, it stops up the entrance with frass (excrement), though sometimes this precaution is neglected, and if it be only a single cocoon the pupa lies partly exposed.

The larva of *B. muralis* are much subject to the attacks of an ichneumon-fly (*Cochlineuman consimilis*). This emerges about the second week in June, and lays a single egg in the larva, which hatches out in a day or two and proceeds to feed on the moth larva. The latter, however, is able to pupate. The parasitic larva continues to gorge itself inside the pupa, in which it remains throughout the winter, to emerge as a fly the following June. The pupæ of both marbled moths are pale yellow, but the ichneumoned pupæ of the marbled green can be distinguished by their dark brown colour, as well as by the semi-transparent appearance of the region where the head should be.

Besides the attacks of the ichneumon-fly, the cocoons of both species are often taken possession of by a spider, and by earwigs

VARIETIES OF THE MARBLED GREEN MOTH (*BRYOPHILA MURALIS*).

The descriptions refer to rows in order—left to right, top to bottom. Except where otherwise stated, the specimens are from Brighton and Eastbourne.

Row I.—1. Blue-green, with black markings. 2. Green replaced by pink, with black markings. 3. Black, with dark olive shading (Devonshire). 4. Black, with grey shading (Isle of Wight). 5. Rich blue-green, reddish markings, fringe plain.

Row II.—1. Rich brown, black markings (Devon). 2. Yellowish-green, black markings. 3. Very pale grey, fawn markings. 4. Deep olive-green, no white (Devon). 5. Pale green, fawn markings.

Row III.—1. Pale green, no dark markings, mealy appearance (var. *suffusa*, Tutt). 2. Pale fawn; slightly darker fawn markings (var. *par*, Hübner). 3. Blue-green, mealy, black markings (var. *viridis*, Tutt). 4. Dark olive-green, olive markings. 5. Dark grey; grey markings. This is the form most nearly agreeing with the var. *impar* (Warren), which occurs at Cambridge.

and woodlice, which will also eat the pupæ.

The marbled beauty pupates about the middle of June—the marbled green rather later.

The colouring of both species is very variable. Usually the fore-wings of *B. perla* are of a whitish ground colour with markings of different shades of grey, but I have taken at Deal and Eastbourne specimens in which all the grey markings were replaced by red or yellow. One, also near Eastbourne, in which the ground colour was very dark grey with darker grey markings. On one occasion at Eastbourne I was fortunate in discovering a pair of *B. perla*, in which the fore-wings were a pearly white, while the markings were scarcely discernible. For this I propose the varietal name *albida*.

As will be seen by the illustration of a few of my varieties, the marbled green is also a most variable species; but no monochrome illustration can give any idea of its shades and colours.

The variation of the above and other species opens up an interesting line of thought as to why one species varies and another, often a sister species, does not, and what are the probable causes of such variation.

It certainly gives an indication of how sub-species and local forms are established. In the case of *B. muralis* (var. *impar*) at Cambridge only the mealy forms as illustrated below are taken; whereas at Eastbourne both the type and the mealy forms are taken on the same wall, a kind of green limestone, very friable—(*see* illustration on page 190). In the latter case the species is no doubt in a state of flux, and in course of time one form will gain predominance. I am of opinion that variety of plant food is one of the causes of certain forms of variation. It is significant that red and yellow forms of *B. perla* have been found on walls covered in reddish and yellow lichen respectively.

In the Isle of Wight I have found the pink form of *B. muralis* fairly common, whereas in Devonshire the very dark form predominates. One would also like to know why these species prefer to rest on walls, in preference to tree trunks and fences, where other species of moths are commonly found. During many years in which I have worked these species, I have only once found a specimen of *B. muralis* on a tree trunk and never on a fence. Another question suggests itself: Why should *B. muralis* be found in the coastal areas—with the exceptions of Cambridge and the Canal Bridge in S.E. London already mentioned—whereas *B. perla* is found both inland and on the coast over the greater part of England?

The first three in rows 1 and 2 are varieties of the Marbled Beauty Moth (*B. perla*): the two lower are specimens of var. *albida*. In the third row are examples of the Cambridge form of the Marbled Green Moth (*B. muralis*, var. *impar*).

*Photo: E. Step, F.L.S.*

The downlands have an intrinsic charm as subtle in its way as the richest lowland vale.

# 3.—SPRING FLOWERS OF THE DOWNLAND

By TICKNER EDWARDES

THOSE who look upon downland country as merely a high-lying lonely waste abandoned to the winds and sheep, will find refutation of their error awaiting them at all times. Especially is this so when the full flood-tide of April song and light and blossom is running high in the meadows and woods of the plains, and the last thing one thinks of is to leave all their squandered luxuriance for the conceived penurious solitude of these bare hills.

And yet, as all down-lovers know, these green, treeless, plover-haunted altitudes of southern England have their seasonal changes as clearly demarcated, and an intrinsic charm as subtle in its way, as the richest lowland vale. Only one needs first to get the true keynote of the downs, as of all wide solitary places on earth—to familiarize oneself, by lengthy sojourning among their rolling, wind-washed hills and dales, with the spirit that pervades them year in and year out : by long and loving study to become initiated into their mystery and allurement, none the less real because so hard to come by if the would-be downlander cling with

too inveterate an obstinacy to the lowland view of things.

The first healthy shock such a one receives on gaining the summit of these green, sun- and wind-swept heights, is that, until now, he has known really nothing about the sky. Hitherto the sky has been but an unregarded roofing to the world; a sort of background to set off the beauty of the leafing tree-tops and the vital grace of birds on the wing. But now the whole heaven stands revealed to the glance from horizon to horizon, and with a catch at heart one suddenly realizes the truth that spring is not alone an affair of earth; there is spring in cloudland as indubitably pageanted as in any greening wood or pied meadow of the vales.

The loveliness of the sky on this April morning of delicate western airs is hardly to be set down in words. Overhead there is nothing but rich pure azure, sending down one unceasing ripple of lark-song which will fail only with the darkness of night. But look where one will, the horizon is silvered with a shining haze, above which float innumerable cloud-forms—the flat-bottomed clouds that are the true advance-guard of summer; of a pearly whiteness, and of a trim and tender grace, though so gigantic; full of blue shadows and vast soaring mountain-tops and dizzy precipices, down which the April sunshine pours in torrents of silver light.

Bright, still mornings such as this are rare in downland. Generally the wind is surging in the grass-bents underfoot, and the great cloud-shadows leaping from hill-top to hill-top—one heaving, billowing ocean of sun and shade stretching away on every hand for interminable miles. Even when there is scarce wind enough in the valley to stir a leaf, one can often find moving, living air on the downs—air that, in the summer heats, will spur up flagging human energy like a draught of wine. Yet the downs have something for every mood; and this is a day not for the high-striding purposeful soul that loves the buffeting of the gale, but for the happy, easy loiterer con-

*Photo: E. Step, F.L.S.*

Ground Ivy whose green-spangled bines thread their way through the crowded grass-bents, strewing amethysts as they go.

tent to let lazy feet, and still lazier thoughts, drift with the tide of the quiet times—to stop or wend onward, study the common grass beneath the tread, or let the eye rove away into the blue infinite above, where all the larks in the world, it would seem, are forgathered to the one sweet, insistent, throbbing strain.

The common grass is always wonderful, anywhere and at any season ; but this grass

*Photo: F. R. Hinkins & Son.*

Almost as bountiful as the daisies, Dog violets shed a tender purple light amidst the rest.

of the downs in springtime, if the wanderer will stop to look at it narrowly, has a secret as well as untold beauty and wonder to reveal. The secret is that, in its soft verdurous deeps, are to be found nearly all the flowers enriching lowland field and hedgerow ; not indeed in the flaunting lush exuberance that one left an hour ago, but in minute sober replica—tiny leaf and blossom almost small enough for a fairy garden laid out within the compass of a single horseshoe print.

It is good now to lie down where the grass at the combe-bottom is densest and longest, and, with slow-winnowing fingers, search out its riches and grace. There is, first, a sort of pergola-roof of flowering grass-heads held high on slender grey-green stems—countless dapples of mauve and rose and umber and silver-grey, poised above everything, and, a little way onward, hiding all the lowlier yet richer growths beneath a scumbling of autumn tint : it is these thronging grass-heads that, from the valley, give the downs in spring and summer their brown, burnt, lifeless look. But this repelling illusion vanishes on any nearer view, and now the soft veiling of the grass-plumes serves but to enhance the vivid loveliness of all that lies beneath.

Daisies innumerable, each scarce half the size of the full-fed lowland daisies, yet, by their very numbers, giving just the same sense of glittering metallic white—seams and crevices and hollows into which molten silver has run and cooled, making a crazy pattern of mirrors for the yellow cowslips that nod between. Downland cowslips lift their gilt sleevelets but half the height of their sisters of the vale, and theirs is an attenuated beauty. But their colour is more gorgeous—all these stunted flowers of the hills seem to gain in intensity of hue what the arid soil denies them in mere girth ; and with these cowslips hiding in the green sward of the combe, not only is the yellow of the flower itself of fresher dye, but the crimson butt of its stalk is more brilliant, just as the crimson petal-tips of the little starveling hill-daisies, if one will turn them up to view, are manifestly of a deeper stain.

With the daisies and cowslips—and all half-hidden in a tangle of moss and ferny undergrowth—are dandelions glowing in the sweet vernal sun, and giving off a scent like old wine ; blue-eyed speedwell like specks of the April sky fallen ; ground ivy whose green-spangled bines thread their way through the crowded grass-bents, strewing amethysts as they go ; rosy dead-nettle, gleaming white archangel, herb Robert with its bold pink stars and leafage rimmed with ruby, dog-violets almost as bountiful as the daisies and shedding a tender purple light amidst all.

Thus is the common grass of downland in the merry springtime. But these little-regarded hills and dales are not all bare sward littered over and entwined with jewels of silver and jewels of gold. The brakes

*Photo: E. Step, F.L.S.*

Here and there like fallen specks of the April sky shines the blue-eyed Germander Speedwell.

*Photo: F. R. Hinkins & Son.*

The age-old trees of gnarled and tortuous growth, shaven and bent by the prevailing wind, have an appeal more telling than that of mere magnitude of stateliness and stature.

*Photo: E. Step, F.L.S.*

Conspicuous amidst the grass-bents and tangled undergrowth clusters the gleaming "Archangel" or White Dead-nettle.

and coppices that island the green waste everywhere, though nothing grows in them that can be called a tree, yet have a like humbler echo of the lordly sky-scraping forestry blotting the sun from lowland dells.

These great patches of age-old, gnarled and tortuous growth have an appeal in their way more telling than mere magnitude of stateliness and stature, and generous girth of bole and reach of bough, such as one associates with grandeur in the forest-trees of the vales. This old ash —here in the heart of the bramble and thorn brake crowning the hill—scarce ten feet high as it is, attains a beauty not to be reckoned in inches but by the long decades wherein it has withstood the brunt of winter tempests, thriving against all odds. The ash is ever the last of woodland growths to yield to the lure of the April sunshine. Even now, in the less sheltered spots of country below, there are ash trees almost without a sign of breaking bud, though their fellow tardy lie-a-beds, the oaks, have capitulated gloriously to the sunbeams long ago. But this old downland ash, scarred and dismembered by perhaps a century's war against hill-top wind and weather, is already donning its summer gala-robe. Coming by a fortnight back, one would have seen only bare grey twigs threaded with buds still retaining all their tight-girt winter blackness. But now on every gnarled bough the flower buds have burst their black shells, and are throwing out huge fuzzy purple tassels, lighting up the whole tree with the rich regal dye.

Yet the crowning glory of the downs in April depends neither upon their emerald sward sown thick with flowers, nor on their spinneys full of blossoming branchlets. Size, intensity of hue, profusion, count for much, and all this is only relatively beautiful; take a downland cowslip or a sprig of this wild highland cherry-bloom to the vales,

*Photo: E. Step, F.L.S.*

The clumps of Red Dead-nettle add touches of a rosy glow to the emerald sward of the downs.

*Photo: E. Step, F.L.S*

With the Gorse, almost always in bloom, one may gaze upon miles of almost unbroken, living gold—a whole countryside fiercely, joyously aflame.

*Photo: F. W. Spry.*

The brakes and coppices that island the green waste of the downs have a like echo of the lordly sky-scraping forestry which blots out the sun from the lowland dells.

and its loveliness is quenched by greater, fuller loveliness, as a glow-worm by sunshine. At this season the downs have something to show that, in itself, for sheer spendthrift lavishness of beauty—wealth of form and colour, heaped measure, pressed down, and running over—has hardly its counterpart in the most favoured region of the plains. The great Linnæus, when he first set eyes on gorse in full bloom in southern England, fell down and worshipped God. Standing now on just such another hillside, and looking away over what, in sober fact, are miles of almost unbroken, living gold—wave beyond wave of shadowless, burning colour : a whole countryside fiercely, joyously aflame—the act of this world-lover from the grey North loses its old-time slur of extravagance for the soberest mind, and the least emotional among us could almost kneel with Linnæus.

*Photo : E. Step, F.L.S.*

Further brightening the scene clusters Herb-Robert with its bold pink stars and leafage rimmed with ruby.

Of all the precious moments in life, that moment is most pregnant of good to a man wherein, by some supreme vision of surpassing natural beauty, he is awakened and shamed out of the common genteel restraint of feeling, so often mistaken for uncommon sense. If the splendour of the downland gorse in April serve not to break this dread entail of repression in the heart of the wanderer who chances to be alone with its stupendous beauty and mystery, such a one is little to be envied. Fervour of spoken words, indeed, has its definite times and seasons not to be lightly ignored. But it is a poor heart that accounts it seemly never to rejoice, even when alone with such a resplendent vision ; such a heart as the fool in the psalm possessed, who said in it, "There is no God."

For see how the marvel and mystery of the thing calls and calls to one under the tender pensive blue of the April sky. It is good to pluck a single one of the yellow flowers, and, holding it in the hand, try to realize all its beauty — its pure colour, its intense sweet fragrance, its winged form. So far, it is humanly understandable : just a scrap of glowing, blowing loveliness, a single grain of living gold from the Eternal Threshing-floor. But now look abroad over these immeasurable acres of blossom, stretching away with scarce a break to the far horizon, and say what it all means—the gorse with its leagues of gold, its chanting multitudes of bees, overhead chippering swallows weaving an endless pattern on the blue ; and, above all else, the first nightingale tolling her silver bell in the wild cherry-bloom hard by.

*Photo: G. C. S. Ingram.*

Not being blessed with a great amount of brain, defenceless young Rabbits make fair game for all kinds of birds and beasts of prey.

# 4.—THE RABBIT AND ITS PROBLEMS

By W. S. BERRIDGE, F.Z.S.

OF the few wild animals that are to be found in Great Britain, the rabbit or coney is probably the most familiar; for not only is it to be found in considerable numbers in suitable localities, but its distribution is also very extensive. It was not always a denizen of our isles, and although no records have been handed down as to when it was first introduced, the animal was known in England and Scotland as far back as the twelfth century. Doubtless it took longer to reach the remote Highlands, but in 1529 it was already abundant in the Orkney Islands.

From what country or countries the rabbit first came is a question that has given rise to a considerable amount of controversy; but it is now generally believed that its original home was in western and south-western Europe.

One of the chief points of interest connected with this animal is its remarkable fecundity. Not only will a pair produce two to five litters in a year, but each of these may consist of as many as ten young ones. As the latter will begin to breed when they are about six months old, it will be realized that their rate of increase, under favourable conditions, is pretty rapid. Thomas Pennant, the Welsh naturalist, records that a single doe rabbit could be responsible for bringing into the world no fewer than

*Photo: G. A. Booth.*

At the entrance to their burrow small groups of young Rabbits may often be found asleep on a sunny day.

fifty-eight offspring in the course of a year, while the late Mr. Lydekker estimated that, if every one were to survive its normal span of life, the progeny arising from a pair would in three years number as many as 13,718,000 individuals!

This excessive fecundity is obviously a compensation to the rabbit for its lack of any means of defence. As it is weaponless, and not particularly clever, the young rabbit is fair game for all kinds of birds and beasts of prey; foxes, stoats, weasels, dogs, cats, owls, hawks, eagles, rats—and man—all rely on the tender defenceless young rabbit for a good part of their sustenance. Thus only can the rabbit outwit them—by producing more and more and more. And in this way he proves in the end too much for the lord of creation himself, since now in many places the rabbit, who was introduced for the purpose of feeding man, has turned the tables on him and lives on the fruits of man's own toil, decimating his crops and robbing him in every direction.

Of course, it can be little compensation to the individual youngster who is carried off by hawk or fox—that there are nine brothers and sisters at home and ninety-nine more to follow, but in the eyes of Nature the sacrifice of the individual seems to matter not one jot so long as the species survives, and it is towards this end that the rabbit, albeit unconsciously, must for ever devote himself.

But though destitute of weapons of war, our timid friend is not without his tools for domestic purposes. He is something of an engineer, and with his strong claws and firm leg-muscles can excavate an underground home. In this snug retreat, at a little distance from the warren, in a chamber lined with fur from her own breast, the mother-rabbit produces her young. The little ones need the extra warmth, for at first they are both naked and blind. When she goes out morning and evening to forage, the doe closes down the entrance with earth, and there the youngsters lie, helpless but safe from the keen noses of prying foes.

Such is the habit of the conventional

*Photo: G. A. Booth.*

Young Rabbits early astir in the sunshine. One at the back is performing his morning toilet.

Photo. W. A. Scott.

**YOUNG RABBITS FEEDING.**

They consume a vast amount of spring grass and clover. If allowed to increase unchecked they will considerably reduce the farmer's hay crop, not only by feeding on it, but by damaging it with their runs and burrows.

*Photo: Riley Fortune, F.Z.S.*

At the first hint of danger the rabbit crouches—flat upon the ground, rigid and motionless.

evening, yet if unmolested and left in quietude, rabbits will come out of their subterranean sanctuaries at almost any time of the day; and it is by no means an uncommon sight on a railway to see the little rodents popping into their burrows, or sitting motionless in broad daylight, while the train passes by.

The normal colour of a wild rabbit is so familiar as to need no description, but it is not so generally known that white, sandy, silver-grey, parti-coloured, and black individuals are sometimes to be seen. Indeed, entire colonies of the last mentioned have been recorded.

rabbit, but, like all living things, some among them have a love of originality, and at times a nest has been found on top of a haystack, and an old scarecrow was once selected as a suitable site. A tame doe I once knew, with more originality than sense, stuffed eight young ones into an old sardine tin—needless to say, not one of them lived to see daylight!

Throughout the spring and summer months the does are occupied with family cares, but the early and late broods are smaller than the others. She is little assisted in her work by the buck; indeed, the father has at times been known so far to forget himself as to eat his progeny.

Rabbits are of a sociable disposition, and many are the romps and games they indulge in on moonlight nights. They live in colonies, and their burrows, which are excavated for preference in sandy soil, frequently cover a considerable area. In wet moorland districts, where the ground is not suitable for burrowing in, the rabbits dwell within the shelter of runs made amongst the thick herbage and heather; while an instance has been recorded of an individual that made its home in a hollow tree, the creature gaining access to its curious domain by ascending the slightly inclined trunk.

Although usually confining their activities to the early morning and

As some people are at a loss to distinguish a rabbit from a hare, it may be of interest to give a brief description of their differences and similarities. In the first instance, the rabbit is much smaller than the hare, and its ears and tail are comparatively shorter. The ears, moreover, are not tipped with black like those of a hare, and the disproportion between the hind- and fore-legs is very much less marked in the rabbit than in the hare. Both animals share the peculiarity of possessing two pairs of incisor teeth (situated the one behind the other) in the upper jaw, but the back pair are so small as to be practically useless. These incisor or cutting teeth continue to

*Photo: G. A. Booth.*

The danger past, he continues feeding unconcernedly.

*Photo: G. A. Booth.*

Young Rabbits making for home. The white tail is supposed to act as a signal to the less vigilant members of the colony.

grow throughout the life of their owners, and under normal conditions are worn down and kept sharp by constant friction against the teeth of the lower jaw. Instances, however, have been recorded of rabbits with malformed and overgrown teeth that projected beyond the mouth in the form of a half circle, or even a complete circle, with the result that the animals died of starvation owing to their inability to feed properly.

When adult, a rabbit weighs from two to three pounds, and measures about sixteen or seventeen inches in length. The peculiar scent that arises from its body is exuded from two glands situated under the tail, which are present in both sexes.

Although one would hardly expect the animal to be as fleet-footed as the hare, yet on the authority of Mr. H. S. Gladstone, writing in *Record Bags and Shooting Records*, it is able to beat its larger relative for the first thirty-five yards or so of its run; but the more normal rate of its progress he estimates to be thirty miles an hour.

The rabbit relies upon its alertness and ability to hide rather than upon its fleetness of foot for evading its enemies. When one of them scents danger it stamps upon the ground with its hind-feet, and the signal is acted upon instantaneously. All within hearing scuttle off to their burrows as

*Photo: Frances Pitt.*

A Rabbit with extraordinary teeth caused by a swelling from a wound which had pushed the lower jaw out of position. The teeth, which are always growing, had thus no "tear and wear," and soon extended so far beyond the jaw that the rabbit, unable to nibble, was actually starved to death in the midst of plenty.

fast as possible with their tails elevated so that the white under-surface is conspicuously displayed.

This snow-white beacon is supposed to act as a guide to the less vigilant members of the colony, who are enabled thereby to see at a glance which way the leaders are running to safety ; but as the hare, which has no underground home wherein it can hide, also has a tail of a similar colour, it is difficult to understand why this should prove beneficial to one and not to the other.

The rabbit has been introduced into various parts of the world, such as Australia, New Zealand, and the United States of America, but instead of turning out to be a welcome addition to the native fauna, it has proved a pest ; its numbers have increased in some districts to such an alarming extent as to defy the efforts of the agriculturist to raise crops of any sort. In Western Australia, the little rodents became so plentiful that the Government found it necessary to wage war against them in an endeavour to prevent them from overrunning the land. Many methods were tried, but with little effect. Weasels, stoats, and mongooses were imported and let loose in the hope that the carnivorous and bloodthirsty aliens would take a heavy toll of the rodents' lives ; and although this expectation was justified to a certain extent, the ultimate result was very disappointing, for the new-comers soon found that the inmates of the poultry runs were more to their liking than rabbit flesh. Rabbits inoculated with the germs of hydrophobia were also set free for the purpose of spreading the disease amongst their brethren, but even this drastic effort proved unavailing.

It was then decided to erect miles of wire netting so as to prevent the rodents from spreading farther afield, and the magnitude of this work can well be realized by stating that one of these barriers erected in Victoria extended for a distance of over one hundred and fifty miles. But in spite of the spending of a vast sum of money, the rabbit still remains " King of the Castle," and it is now realized that there is no probability of their numbers ever being reduced to any appreciable extent.

*Photo : Frances Pitt.*

Though destitute of the weapons of war, the Rabbit is not without his tools for domestic purposes. With claws and firm leg muscles he can excavate his home.

# How to Recognize the Fungi

A "Fairy Ring" of St. George's Mushrooms (*Tricholoma gambosum*) may contain as many as a hundred solid-looking specimens as big as your fist. They may be found anywhere in open grassy places about the fields or downs.

## 1.—A DISH OF SPRING MUSHROOMS

By EDWARD STEP, F.L.S.

With photographs by the Author

A PREVAILING notion respecting mushrooms is that they are to be found plentifully only in late summer and autumn, and that no one who knew anything about the matter would waste his time looking for them in winter or spring. In spite of this dictum the rural rambler in spring may come across so abundant a supply that he will regret that he has not brought with him a half-bushel basket to gather some for his friends as well as for his own table. It is even possible, where one has the experience of former years to guide one, to go deliberately to a certain locality with the intention of bringing home a supply of mushrooms of more delicious character than could be found in summer. Of course, in this adventure the British climate and its vagaries would have to be considered, for Nature takes note of weather conditions more than of precise dates.

The most notable of the edible spring fungi is one known as St. George's mushroom (*Tricholoma gambosum*), so called because in an average spring it will appear somewhere about the day of that saint—April 23. As one result of this early appearance, it forms a good point from which

the uninitiated may make an attack upon the hordes of fungus species. This attack is opened usually in autumn when the profusion of obviously distinct forms forces them upon our attention, and the tyro gathers so many that it is impossible to work out their identifications whilst they are fresh. Too frequently he concludes that the task is hopeless, and gives it up. But when he has only this one of the typical mushroom form to consider, it is an easy matter to make himself familiar with everything concerning its shape, size, colour, smell, taste, the characters of its cap, its meal ; to me, it has always been suggestive of castor-oil. When the cap has fully expanded it may measure four or five inches across. Often its kid-like surface is deeply scored across, owing to the struggle it has had in pushing its way up through the turf, through which may run a tough horizontal root or two. It cracks also from the skin not expanding so quickly as the fleshy substance of the cap.

Turning the mushroom upside down, the whitish gill-plates are seen radiating from the stem, to which each is attached by a sort of tooth following a little gap in the

Although nothing certain is known of the edibility of the pretty Marsh Mitre (*Mitrula phalloides*), it is worth hunting for among thick deposits of decaying leaves, or around ponds bordered with sphagnum moss.

gills, its stem and the manner of its growth.

To begin with, where is this desirable comestible to be found ? Not in the woods or in the meadows, but in pastures where the grass is kept short by browsing animals, preferably by sheep, and in open grassy places such as the chalk-downs. There you may come upon a cluster of two or three, half a dozen, or an extensive ring of a hundred solid-looking mushrooms as big as your fist, on short thick stems. Its colour is a pale tan, fading away to cream tint at the margins of the cap, the centre of which in the larger specimens is somewhat cracked. As you get near to it you are conscious of an odour not at all resembling that of the common mushroom. Some of the authorities liken it to the fragrance of newly ground edge of the plate. The microscopical spores are produced in millions on these plates. They are white, elliptical in shape, and their longest diameter is 13 or 14 micro-millimetres, or between an 18 and 19 hundredth-part of an inch.

If our find be a cluster consisting of two or three mushrooms only, we may know that it is the beginning of a new colony ; if a ring, we may estimate its age by the circumference. This is the story : One spring when the St. George's mushrooms had reached their full expansion, the minute spores dropped from the gill-plates, and one of them chanced to be borne on the air to this spot. Washed into the ground by rain, it germinated and grew into a long branching filament resembling a delicate strand of cotton. After many months of

branching and felting, due to its absorption of food from the humus, a few little knobs appeared on some of the threads and gradually enlarged until their tops pushed through the grass, the stem lengthened and the hemispherical cap spread out until it was broad and nearly flat.

That represents the first year of the fungus. In order to produce that cluster of two or three mushrooms, the plant has extracted all its special food that was in the humus immediately below them ; so the cottony threads now spread out in all directions in order to tap the surrounding soil and obtain further food. The result is that the mushrooms of the second year are all produced at a distance from the site of the first year's group, and as growth of the threads (*mycelia*) has been pretty equal on all sides, mushrooms of the second year form a small ring above ground. By a continuation of the forward extension of all the threads in their pursuit of fresh feeding grounds, the ring becomes larger every year, until it may chance to cut into another ring advancing towards it, or the threads of one segment encounter stones or sterile soil, by which their further advance is stopped. So the ring gets broken up ; and broken rings or detached segments of circles are met with. One of the photographs shows a ring in this stage ; and it will be seen that it consisted of a considerable quantity of good, wholesome food. When a small cluster of these mushrooms is formed in spring, a note should be made to visit the spot a year later, when we shall be almost sure of finding a small ring of them, and larger rings for several years in succession.

The St. George's mushroom is so good and savoury when cooked that no one will refuse a second supply. The expert mycophagists, indeed, assert that it is the most delicious of the whole tribe. It is said to be the species to which the term mushroom rightly belongs, for to it the distinctive word *Mouceron* was originally applied.

In strolling through a wood where a few years previously we have watched the charcoal burners at work, it is worth while looking up their old hearth. Or in sauntering along one of the broad, green lanes that afford so much entertainment to the naturalist, we may come across the blackened circle where gipsies camping for the night cooked their supper. In either of these places, especially if on clay or chalky soil, we may in springtime come upon a cluster of the eagerly sought morel. So distinctive are the forms of the morels that they can be recognized generically off-hand. We have six different British species, and they agree roughly in their most striking feature ; there are also two closely related species that differ in this point, but the whole eight of them may be eaten by those fortunate enough to find them.

The edible Turban Morel (*Gyromitra esculenta*), one of three rare species, is quite distinct from *Morchella*, notably, in the shape of the rich brown, velvety head, which instead of being pitted, is thrown into lobes and folds.

Owing to the frequency with which it has

been illustrated, the general form of the common morel (*Morchella esculenta*) must be familiar to most of our readers. There is little resemblance here to the ordinary mushroom form—the outspread umbrella shape of the cap with radiating plates or a layer of sponge on the under surface. In the morel we have a short, stout, whitish stem, surmounted by a yellow-brown head,

Smith's Morel (*Morchella smithiana*) stands about a foot high, and has a huge, substantial-looking stem, which is really a comparatively thin-wall cavern. By one authority, it is regarded as a species distinct from *Morchella*.

which may be round, oval or oblong, with its surface sunk into pits, which rarely have any resemblance to the regularity of the published drawings. This is one of the numerous cases demonstrating the superiority of photography over draughtsmanship in depicting the detail of natural objects. As in all the members of this group, the massive-looking head is a mere shell, the central space continuous with the hollow stem.

The thick-stemmed morel (*Morchella crassipes*) is very similar, but larger and more substantial looking ; this appearance being due in part to the thicker ribs separating the larger and fewer pits. The head is deep brown and the flesh-tinted stem is longer than the head.

Another species, the conical morel (*Morchella conica*) is distinguished by having the head tapering upwards and the principal ribs, which are thick, running vertically, and so causing the pits to be elongated. The head is bistre coloured with variations towards grey and olive.

Smith's morel (*Morchella smithiana*) was considered by its discoverer, the late G. Worthington Smith, to be a variety of the thick-stemmed morel, but M. C. Cooke regarded it as a distinct species. It stands about a foot high, and as shown in the photograph, has a huge, substantial looking stem, though as a matter of fact a slight push with the finger will annihilate it, for the stem is a comparatively thin-walled cavern. The specimen photographed had passed its prime before I found it, and the head is somewhat collapsed, but the opportunity for seeing this splendid form does not come frequently.

The distinctions between some of the morels are not very sharp, and it would not be surprising if closer investigations showed them to be more nearly related than they are said to be in existing text-books.

The small neighbouring genus, *Gyromitra*, to which we have given the English name of turban morel, is quite distinct from *Morchella*. The three species are rare, and I have been able to photograph only one of them (*Gyromitra esculenta*). In this it will be seen that the rich brown, velvety head, instead of being pitted, is thrown into lobes and folds. In general form it is round and hollow ; the flesh thick, firm, and white beneath the coloured surface. The stout stem is hollow also, of a whitish tint with a fine downy surface. In the photograph it

The familiar Common Morel (*Morchella esculenta*) resembles but little the ordinary outspread umbrella-shaped mushroom. In spite of its unattractive appearance, it is quite wholesome to eat.

appears as though two stems are united, but this is due to an inward fold of the single stem. Its habitat is under pine trees, usually on sandy soil or where the surface has been burnt. Berkeley warns fungus-eaters that this species sometimes disagrees with those who have partaken of it ; but he adds that this may depend upon a peculiarity in the constitution of the eater rather than upon any pernicious property of the fungus—just as some people cannot eat with impunity the common mushroom, the crab or mackerel.

Related to the morels, but even less known, are the *Helvellas*. There are no fewer than fifteen British species, and all of them are rare, except that the white helvella (*Helvella crispa*) is in certain places locally abundant. They are all summer or autumnal mushrooms, but the black helvella (*Helvella lacunosa*) appears in spring as well as in autumn. The black helvella is not so black as its popular name indicates, being really coloured a greyish-black ; but when in autumn *Helvella crispa* and *Helvella lacunosa* are found side by side, the contrast is so great

The little-known Black Helvella (*Helvella lacunosa*), despite its name, is really greyish-black. It is related to the morels, and appears in spring as well as in autumn.

The fully expanded cap of the St. George's Mushroom may measure some four or five inches across. Underneath, each radiating whitish gill-plate is attached to the stem by a sort of tooth following a little gap in the edge of the plate.

that they are distinctly the white and the black helvellas. Apart from this difference of colour, they are quite unlike in the form of the head. This is inflated, and consists of two to four lobes, whose lower edges are at first attached to the stem, but later become free. It will be seen by the specimen to the left of the photograph, which has been nibbled by a slug, that the head is hollow; so is the ribbed and channelled stem, whose natural openings afford easy access to the woodlice and earwigs that commonly shelter within. This is an edible species, but my own experience is that with simple cooking it is scarcely worth gathering, though the culinary artist, with the aid of stuffing, sweet herbs and spices, may make a tempting dish of it. It is found in woods and copses.

Although nothing certain is known as to the edibility of the pretty marsh mitre (*Mitrula phalloides*), it is well worth hunting for in wet places where there are thick deposits of decaying leaves, or around ponds that are bordered with sphagnum moss. It is a very fragile, waxy-looking fungus with a slender white stem which may be tinged with pink or yellow. The more or less globular hollow head is glossy and of a beautiful orange-yellow colour. It is by no means a well-known species, but in appropriate places it may sometimes be found in considerable numbers; and as its season, opening in spring, is continued through summer to autumn, there are sufficient opportunities for making its acquaintance.

Lastly—the list is growing somewhat long—we may mention a rather substantial fungus that may be found at home, where there is a kitchen garden with well-manured soil. This is the bladder-like wax-cup (*Peziza vesiculosa*). It may measure as much as three inches across, and is at first globular or top-shaped, then splitting at the summit and forming a deep cup with thick walls of brittle, wax-like flesh. On the outside it is dirty-white and rough with bran-like scales; the inside pale brown, or in one form yellowish. Often the cup extends downwards into a sort of stalk from which the white vegetative threads branch off. Sometimes it will be found growing on heaps of dead leaves or stable-manure; but it is much more likely to appear on the worked soil of the garden or allotment than on that of the woods, heaths or downs. It is on the list of edible species, but does not appear to have any special recommendation.

The well-manured soil of a kitchen garden produces the rather substantial fungus of the bladder-like Wax-cup (*Peziza vesiculosa*). This also is on the list of edible species.

# THE FAIRYLAND OF NATURE

Pages for the Children

By OLIVE HOCKIN

## II.—What Popsi Found in the Attic

POPSI was in a scrape.

Lessons were over for the morning and the others had run out to the orchard. But Popsi was kept in.

It had been such a wonderful spring morning, somehow she could not keep her attention on English History; all the time she had been thinking of those little robins who had hatched out the day before. So instead of learning her lessons she had done nothing but wriggle and look out of the window where a bough of larch was swinging against the sky. It was so much prettier to look at than the old lesson book, for queer little tufty, bright green brushes were set all along it, and at the end were three waxy, rose-pink flowers.

Popsi began making up a story about them, pretending it was a shop where the fairies bought little green shaving brushes—and perhaps the

Photo F. St. J.

"Little tufty, green brushes were set all along the larch bough."

*Photo: Riley Fortune, F.Z.S.*

"It stood for one minute looking through the glass."

waxy flowers were a new kind of soap; she was sure fairies would use pretty soap . . .

But all that was not English History. So here she was, an unhappy little mite, kept indoors, climbing alone to the attic.

To the children the attic was the nicest room in the house; here there was no furniture that they could spoil; one sat on the floor in a simple, natural way, and toys and tools were here, there and everywhere—just where one was most likely to need them.

Popsi lay flat on the floor by the dusty window. As she lay thinking over her troubles and longing to be out, she thought, presently, that she heard something rustling. In the corner there was a loose pile of straw that had covered some seed potatoes, and amongst it something was surely moving.

Popsi lay as still as still, waiting to see what would happen.

The rustling continued, and presently out poked a little sharp, brown nose. Very silently, out it came—a little brown-coated animal with bright eyes and a long tail.

It was a rat!

To the children, who loved all animals, even a rat was just one more little four-legged friend, and Popsi lay quiet, wondering what it would do.

The little thing sniffed round as if suspecting something strange, but as there was no movement he did not seem troubled. He sniffed at the window, stood for one minute on his hind legs looking through the glass, and then made for a little hole in the floor beyond, squiggled through, and was gone.

But the rustling continued.

Popsi jumped up and began to search amongst the straw.

And there, in the corner, in a nest of dry grass and fibre, curled up snugly and breathing softly, were half a dozen round, fat, pink and grey rat-babies.

That *was* a discovery!

Popsi was just putting out her hand—for her fingers must ever be into whatever she sees—when the door burst open. Topsy and Boodles tumbled into the room.

"Popsi!" cried the former, "what do you think has happened?"

*Photo: A. M. C. Nicholl.*

This is the Robin building his nest. He is looking round because he hears the children coming, and does not yet know that they have promised never to disturb nests or eggs.

"Our poor little robins!" cried Boodles, with tears in his eyes.

"What? What is it?" cried Popsi, sitting back on her heels.

"Why—they're gone!" said Topsy. "A rat has gone and taken them all. Jenkins said he saw it early this morning!"

"Oh!" cried Popsi. "And here are the very rat's babies—I've just found them!"

All the children gathered round, looking at the nest in dismay.

"Daddy did say rats never ought to be allowed to live," wailed Popsi. "But I did think the babies were sweet."

"Who would have thought an animal could be so wicked!" said Topsy.

And then, all in a minute, through the window, came Spring.

"What are you worried about, children?" she cried.

They told her all the trouble.

"Dear, oh dear!" said Spring. "But you know, you must not blame the rat! She had her own little ones to think of. Don't you children ever eat chicken for dinner yourselves? Or pheasant, when you can get it?"

"Oh! did they think the young robins were pheasant, then?" asked Popsi.

"I expect they must have!" said Spring. "But still, I am sorry about it. We can't afford to have too many rats in the world, and I certainly wish they would leave the young birds alone. Just you leave it to me, children, and I'll see what can be done!"

But what Spring did about it I must tell you next time.

*Photo: Riley Fortune, F.Z.S.*

"Curled up snugly and breathing softly were half a dozen round, fat, pink and grey rat-babies."

*Photo: Capt. H. Morrey Salmon, M.C.*

The Razorbill lays but one large egg on the ledge of some high sea-cliff. It is here represented about half actual size.

# 10.—THE EGGS OF BRITISH BIRDS

By A. LANDSBOROUGH THOMSON, O.B.E., D.Sc.

EVERY kind of bird lays eggs which, even in the external appearances of the mere shell, are characteristic of itself, and which are adapted to the conditions under which they are laid, incubated and hatched. Thus we may read some meaning into the various points which distinguish one kind from another, if we consider the eggs in relation to the habits of the birds to which they belong. We may begin by dealing with eggs in the plural and considering the number of eggs in a "clutch" and the number of clutches laid in a season, and from that we may pass to the individual egg and try to find the significance of its size, its shape, its surface texture and its coloration.

A few of our British birds lay only a single egg; each year a female guillemot or razorbill, for instance, lays but one large egg on a ledge of some high cliff rising from the sea. Two is the normal clutch, rarely exceeded, of such birds as the wood-pigeon, the golden eagle, and the red-throated diver. Three is a characteristic number for the gulls and others, but here we begin to get variation in the numbers, clutches of two or four being frequent in the case of many species for which three is the commonest figure. Four is also a common clutch, and in the case of most of the plover kind this number is maintained with remarkable regularity. Five or six eggs are laid by many kinds of birds, and among some of the small song-birds clutches of from seven or eight to a dozen

or so are the rule. Still larger numbers are sometimes found in the case of certain game birds and some of the ducks, but clutches over a dozen are often suspected of being the product of two birds laying together.

Although most birds will lay again if their eggs are destroyed or taken, or if they birds do before laying again, and a mother may thus be seen late in the season with young of three distinct ages.

The number of eggs laid in a season, whether in one clutch or by instalments, has obviously a bearing on the rate of multiplication of the species concerned. This in turn

*Photo : Stanley Cr ok.*

The Guillemot lays but one egg—pear-shaped—on the bare rocky ledge of a steep cliff. When disturbed by the wind the egg tends to roll in a circle round its pointed end. This series of eggs, from Bempton Cliffs, Yorkshire, shows the remarkable variations in the markings. The colour also varies greatly.

are induced to desert their nests, many birds do not normally lay more than one clutch in a season. Among the small song-birds especially, however, we find frequent cases in which two or even three broods are as a rule reared each year. The moor-hen also lays twice or thrice in a summer ; furthermore, it does not leave the young of the first brood to fend altogether for themselves as most

depends both on the risks of " infant mortality " and on the natural degree of longevity. Obviously, if the various species of birds are to hold their own numerically, the rate of reproduction must be greater in the case of the shorter lived birds and of those which are more especially exposed to losses of eggs and young.

There are factors which may lead to

CORMORANT'S NEST WITH EGGS.

A rough coating of chalk generally covers the under shell of the egg, which is a pale blue.

*Photo: B. Hanley.*

The normal eggs of the Woodcock are mottled brown, and harmonize completely with their surroundings. The abnormality of a clutch of pure white eggs, found by the author, serves to demonstrate the incompatibility of white with the bird's nesting habits.

variations in the average clutch for a given species, but reliable statistics are lacking to show what influence may be exerted by geographical or seasonal differences in climate. It is interesting to note, however, that the plagues of voles which have occurred in parts of the country from time to time have led to increases in the number of short-eared owls breeding in the affected areas, and that under these circumstances of super-abundant food unusually large clutches have been the rule among these birds. There is, therefore, some ground for supposing that more eggs may be laid under particularly favourable circumstances, and that if climate has not a direct effect it may at least be important indirectly on account of its influence upon the food supply. The age of the individual bird may also be a factor, and it is thought that the exceptionally small clutches which are to be found may often be the produce of a young hen breeding for the first time and not yet in full reproductive vigour; the same might happen in the case of an old female were it not for the fact that few wild creatures ever survive to become senile.

The size of the egg naturally depends largely on the size of the bird; but there is another important factor which it is interesting to note. As we shall mention again more fully in another chapter, there are great differences in the stage of development at which various kinds of birds emerge from the egg; some are hatched in a condition of blind and naked helplessness, while others from the very first moment are open-eyed, down-clad and active. A more developed condition at hatching usually implies a longer incubation period, and this in turn tends to require an egg of larger dimensions in proportion to the size of the bird. Incubation may last for something less than a fortnight, as in the case of small warblers, or it may extend to a month or more. The eggs of the cuckoo are disproportionately small, but here the

*Photo: F. T. Newman.*

The eggs of the Wryneck, or "Cuckoo's Mate," are pure white. This nest was found in a hollow plum-tree from which the side was cut to display the eggs. It is conceivable that white eggs may be of advantage to a hole-nesting bird, which can thus see the clutch in the dim light.

special conditions characteristic of this bird's life, discussed elsewhere in these pages, are operative.

The shape of egg which is familiar to us in the case of the domestic fowl is one which is commonly met with among birds of many different kinds, and it may be remarked in passing that it is the broad end which generally emerges first in the process of laying. more than one egg, the same explanation obviously does not hold good. Here the shape is of advantage owing to the precarious site on which the egg is laid on the bare rocky ledge of a steep cliff; when disturbed by the wind or by the shock of the departing bird, the egg tends to roll in a small circle round its pointed end (this cannot be demonstrated with an empty eggshell) and so to

*Photo: T. Ball.*

The Partridge, like other game birds, lays a large clutch of eggs, which are fine-grained and shiny. They present an example of fine surface texture.

In some birds, however, both ends of the egg are almost equally rounded. The proportions of length and breadth also differ from one kind of bird to another; the eggs of owls approach the spherical, while those of the swift have a long but narrow oval shape. Very much pointed eggs are typical of the plover kind, one half being almost conical in shape: these birds lay four eggs, as we have already noticed, and they always place them with the points towards the centre, thus achieving a compact and easily covered arrangement which would not be possible with a different shape. The guillemot lays a pear-shaped egg, but as there is never avoid disaster. Nevertheless, many of these eggs do fall off the cliffs, thus showing the reality of the danger.

Of surface texture it is not necessary to say much. The extremes are the fine-grained shiny eggs of the partridge, and the cormorant's rough chalky eggs from which the outer layer can be chipped off. In the case of the cormorant, and also of its ally the gannet, the chalky layer is white, but the firmer layer beneath, although not ordinarily visible, is pale blue in colour. The puffin is another bird with an eggshell of rough texture.

It is in their coloration that eggs are most

interesting and most beautiful. Pure white eggs are laid by many species, but others lay eggs of buff, of green, of blue, or of brown, while the eggs of some birds of prey may almost be described as red. There are, however, no black eggs. The colouring may be confined to the ground colour, or the egg may be marked with spots or streaks or blotches ; fine lines, too, are characteristic of the buntings and have earned for them the popular name of " scribbling larks." The markings, moreover, may be evenly distributed or may be concentrated in a belt round the broadest part or in some less regular pattern. The more richly marked eggs, especially, may vary greatly in the case of a single species : particularly is this so for the guillemot, where the prevailing colour of the shell may be white, buff, green, blue, brown or even reddish. The eggs of the cuckoo, always an exception, are also subject to great variation, as has been noticed in another chapter.

*Photo : Henry Irving.*

The characteristic fine line-markings of the eggs of the Common Bunting have earned for the bird the name of the "Scribbling Lark."

The coloration of birds' eggs is very largely protective, an idea neatly conveyed by the single word " camouflage," which has recently been added to the English language (to the great convenience of naturalists !). Thus we find that eggs of bright green or blue commonly belong to birds whose open nests are to be found among the greenery of hedgerows or thickets, while brown eggs are characteristic of those which lay on the bare ground of field or moorland. Anyone who has ever searched, and not improbably searched in vain, for lapwing's eggs in a ploughed field, or better still for oyster-catcher's eggs among the shingle of a riverside, will fully appreciate the efficacy of the device.

Many eggs are, of course, laid in situations where camouflage is unnecessary, and it is among these that we find most of the uncoloured eggs. The pure white eggs of owls, of woodpeckers, of the kingfisher, of the swift, and so on, are laid in holes, and those of the dipper are contained in a domed nest. It may be added that there may be a positive advantage in white eggs in holes or covered nests, as they may be more readily visible to the parent birds in the dim light. But whether some birds have white eggs because they nest in holes, or whether they nest in holes because they have white eggs, is not a problem which we need argue here ; the undoubted relationship between the two facts is sufficient for our purpose.

The present writer once had the good fortune to see a clutch of pure white eggs laid by a woodcock, and this strange abnormality vividly illustrated the value of the camouflage which this bird's eggs usually possess. As a rule they are of a mottled brown colour which makes them very difficult to find among the brown tints of the ground beneath the trees, but in this case they stood boldly out and were conspicuous objects from many yards away. The sitting bird had deserted, alarmed either by the strangeness of the eggs which it had brought forth or by the embarrassing interest which they aroused.

NEST AND EGGS OF THE SONG THRUSH.

NEST AND EGGS OF THE WILLOW WARBLER.

*From Coxen Transparencies by Reginald A. Malby, F.K.P.S.*

*Photo: B Hanley.*

A characteristic clutch of three eggs of the Black-headed Gull, laid in a bulky nest in a damp situation.

*Photo: B. Hanley.*

The Snipe lays a clutch of four eggs. Blotches and spots with various underlying markings are more numerous at the larger end.

*Photo: T. Ball.*

The Common Tern will sometimes build a rough nest for its eggs. The ground colour of the latter may vary from stone-grey to umber-brown.

The incident served to demonstrate the incompatibility of white eggs and of nesting habits like those of the woodcock and other ground birds.

These, then, are a few of the characteristics of the eggs of our British birds, and a few of the points of interest with regard to their numbers, their sizes, their shapes and their colours. But it should be remembered that the most wonderful thing about an egg is the marvellous process of development within it, whereby a microscopic cell grows in a few brief weeks to be a bird. And when this bird comes out into the world, the mere coloured eggshell—often sought by collectors to the exclusion of the study of living things—is cast aside as having served its purpose. These inner mysteries of the egg do not come within the scope of the present work, but of chicks and nestlings from the time of hatching we shall have further occasion to speak.

*Photo: T. Ball.*

On other occasions the Common Tern simply lays its eggs on the bare ground. This photograph was taken in the same locality as the one above—Goswick Sands, Northumberland—and illustrates the variation in markings of the eggs of this species.

## AN OYSTER CATCHER APPROACHING HER EGGS

**Laid in a shallow hollow on sand or shingle, these eggs afford striking evidence of the efficacy of Nature's camouflage devices**

*Photograph by T. M. Blackman*

As the Kingfisher's eggs are laid in inaccessible places camouflage is unnecessary. They are pure white

*Photograph by Stanley Crook*

The mottled brown and green coloration of the Skylark's eggs is characteristic of birds which make their nests in the open field or moor

*Photograph by J. T. Newman*

The Lapwing lays very pointed eggs, and almost invariably a clutch of four. She arranges them symmetrically, points inward, so that they occupy the minimum of space

*Photograph by Howard Bentham*

The Moor-hen lays two or three clutches of eggs in a summer, and, unlike most birds, keeps the chicks from each with her all through the season

*Photograph by Niall Rankin*

Many sea-birds only lay one egg, but three is a characteristic number for the Black-headed Gull

*Photograph by T. M. Blackman*

The Lesser Tern often makes no nest at all, but lays her eggs on the beach, where they are almost invisible amongst the stones

*Photograph by G. C. S. Ingram*

The Solan Goose, or Gannet, will collect floating seaweed or straw with evident delight. Nest-building becomes a habit with these birds and continues until autumn.

# 11.—A REMARKABLE BIRD OF THE OCEAN—THE SOLAN GOOSE

By SETON GORDON, B.A., F.Z.S.

With photographs by the Author

TOO many voyagers, even those who know little of birds and their ways, the white-plumaged solan goose—or gannet as he is sometimes called—is a familiar object. He is met with during the crossing of the English Channel, the Irish Sea, and the North Sea, while on the Atlantic Ocean, hundreds of miles from land, he may be seen skimming the great waves with strong purposeful flight. He is a bird undismayed by even the fiercest storm, for he is of Spartan upbringing.

There is perhaps nothing in the bird world so entirely callous as the manner in which the parent solan takes leave of her young.

For fully twelve weeks the young solan goose is in the nest. Observations made by a naturalist lighthouse-keeper show that, in a certain nest under constant observation, the egg (the gannet lays but a single egg, white and chalky) was laid on April 23rd. It was hatched on June 8th, and the young bird did not take its first flight until September 5th. It was weighed every day, and during the last week it lost two ounces, so it seems as though food were purposely withheld from the young gannet in order that the pangs of hunger should compel it to take its first flight. At the age of one day the young solan weighed $2\frac{3}{4}$ oz.;

in a week its weight had increased to 7½ oz., and in a month to 3 lb. 7 oz. Eight weeks from hatching it was a heavy bird of 6 lb. 15 oz., and when twelve weeks old it turned the scales at 7 lb. 2 oz.

Unlike its parents, the young gannet when it first flies has a plumage of a dark slate colour, spotted thickly with white. The spots quickly disappear. It is not until the third or fourth year that the complete white plumage is assumed, and all through this lengthy period (during which, of course, the bird does not nest) the dark plumage gradually is lost, the gannet in the course of its second summer appearing almost black and white.

Young Solan Geese, when they first fly, have dark slaty plumage, spotted thickly with white. Although the spots quickly disappear, the complete white plumage is not assumed until the third or fourth year.

One might naturally suppose that the young gannet's first flight would be a matter of considerable anxiety to its parents—that they would gently persuade the novice to launch itself out over the great cliff, with the angry sea hundreds of feet beneath it, and accompany it out over the waters. In doing so they would be acting quite in accordance with the procedure generally adopted throughout the bird world. Yet what actually is the case? The young gannet makes the first flight entirely unaided, even unwatched. Its parents do not accompany it—do not show the least interest in its fate. If it be lucky it escapes the jagged and projecting ledges of rock. If it lose its nerve—and this frequently is the case—it is dashed from ledge to ledge and falls lifeless in the sea beneath. I shall always remember the row of corpses that lay one mid-September day along a raised terrace of rock just above high-tide mark on the Bass Rock. These were young gannets for which the ordeal of that first flight had proved too severe, and I was a witness of several such tragedies during the course of the day.

The young gannet, then, starting from its nesting ledge several hundred feet above the sea, is able to fly a considerable distance

**POISED.**

A study of a Gannet alighting beside its young on the Bass Rock.

When studied at close quarters the Gannet has the appearance of being a bird of callous disposition. Its sagacity does not seem great, and, indeed, the youthful Solans have a wiser aspect by far than their elders.

in which the golden eagle escorts its eaglets from the nest, keeping with them, and with great patience teaching them first to fly, then to hunt. The eaglets indeed remain constantly with their parents for several months after they leave the eyrie.

When studied at close quarters, the gannet, or solan goose, has the appearance of being a bird of callous disposition. Its sagacity does not seem great, and, indeed, the youthful solans have a more intelligent aspect by far than their elders. This suggests before it falls with a splash into the water. It has made desperate efforts to avoid this, for the ocean is entirely unknown, and it does not yet realize that it can be even more at home here than upon dry land. But having made the first unwilling plunge it finds this new element not unpleasant, and commences to bathe and clean its plumage, soiled by so many weeks' contact with the rock.

Now, one might surely think, the parents would appear on the scene to initiate their child into the mysteries of capturing the wily herring, or the swift-swimming mackerel. Not a bit of it! With incredible callousness, from the human standpoint, they have seemingly entirely forgotten their only offspring, which must perforce learn for itself the art of fishing, and master unaided the problem of facing the stormy waves and battling against the gale. How it does so is a mystery, but it leaves the rock with an abundance of fat, and is thus able to tide over the time of its greatest helplessness. It is a harsh upbringing, very different from the careful manner

Young Solan Goose seen at the stage when feathers are beginning to replace the down.

The Solan Goose is more at home on the sea than upon dry land. Here he is seen dropping to the water in the teeth of a stiff breeze.

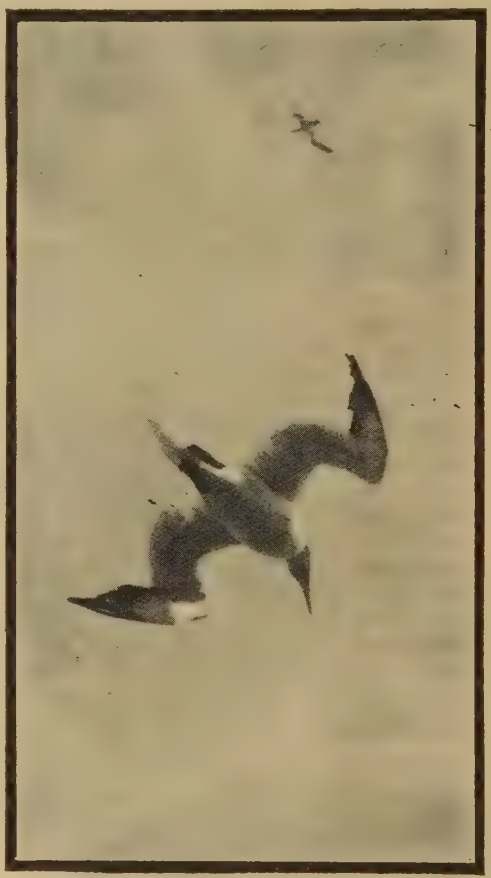
tion of callousness may be due partially to the creamy-white colouring of the iris, and to the unusual slate-blue eye-rim. One dark-eyed gannet—the only one of this description, so far as I am aware, that has ever been chronicled—was observed regularly on the Bass Rock, and nested for seven years in almost the same situation. This bird had a more pleasing appearance than his light-eyed brethren.

The eccentricities of the Solan Goose extend even to nest-building in September. No eggs are laid in those autumn nests, but at such a time it is humorous to see the thefts of materials which frequently occur in the colony.

A Solan Goose planing downwards to the sea.

The solan goose is a bird of more than one eccentricity. Most birds have a certain well-defined nesting season in the spring or early summer of the year. The gannets, like other fowls, lay their eggs in April and May, but frequently add to the old nests, and even construct new ones, all through summer and

autumn. After a heavy wind from some easterly direction, the North Sea around the Bass Rock is strewn with sea wrack, and I have watched, of a mid-September day, the gannet colony of the rock busy collecting this floating weed with evident delight. If floating straw be present it is eagerly pounced upon by the birds, and new nests (no eggs are laid in them so late in the season) spring up rapidly. At such a time it is humorous to see the thefts which frequently take place in the colony, some crafty and unscrupulous bird robbing his neighbour while the latter is away hunting for further nesting materials. Unlooked-for things have been found in a gannet's nest. I have seen a golf ball lying beside the egg, and a small toy wooden spade has also been found. Now from the Bass Rock to the golfing town of North Berwick is a distance of not many miles. At one tee of the North Berwick course a sliced shot lands the ball upon the seashore, and even—at high tide—in the water itself. Thus upon the sea hereabouts a number of golf balls must habitually float, and a roving gannet, spying one of these, evidently considered it a fitting adornment for its nest. Gulls sometimes carry off golf balls, apparently taking them for some curious egg. Their disappointment when they find the "shell" hard and unyielding must be comical. During a recent summer a golf ball was lost in a field on the Outer Hebridean island of South Uist. A month or so later my wife and I were visiting the islands of a large moorland loch some two miles distant. Upon one of these islands—where a colony of lesser black-backed gulls nested—we found the missing golf ball!



On sighting a fish, the Solan swerves suddenly, and sweeps down at great speed, plunging into the water to a considerable depth. Unlike the golden eagle or the peregrine falcon, his wings remain open in his downward "stoop."

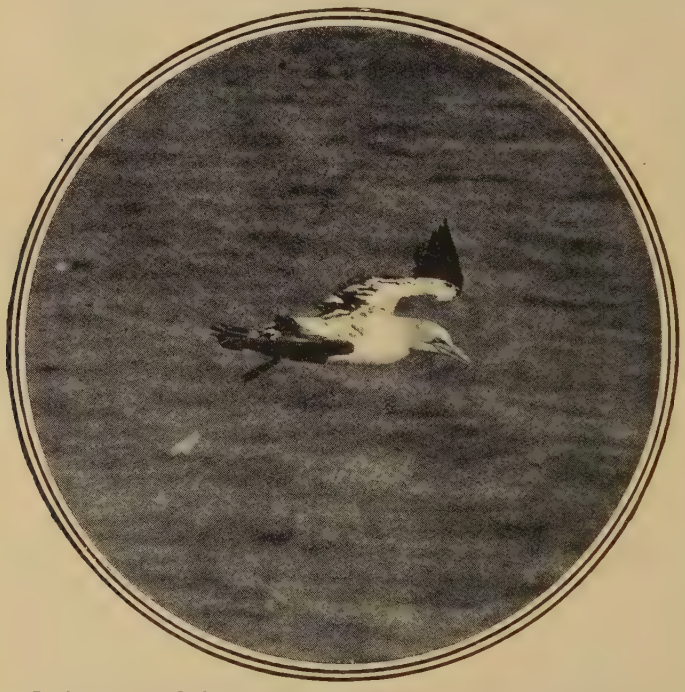
During the summer months solan geese range far in their fishing. I have often thought it would be very interesting to discover exactly how far they do wander from their nesting rocks, though I fear that would be impossible. St. Kilda lies some sixty miles north-west of Barra, and throughout the summer months gannets may be seen daily, even hourly, passing through the Sound of Barra. Certain of the birds are obviously setting their course for St. Kilda; others are just as certainly coming from that lonely island set far into the Atlantic. The birds flying from the direction of St. Kilda are apparently making for some definite fishing ground, and throughout the summer many of them may be seen fishing in the sea-lochs of the Island of Mull. It is difficult to believe that all these gannets are non-breeding birds, so it seems that some of them, at all events, are on a fishing expedition from St. Kilda, although that island is just over a hundred miles distant from Mull.

The prey of the gannet is chiefly herring and mackerel, and it is almost incredible

**WHERE THE GANNET NESTS.**

A scene on the precipitous face of the Bass Rock.

what a number of these fish they are able to swallow. When gorged with food a solan goose is unable to rise from the water. Should he be approached by a boat he may be unable to save himself, or else, disgorging the fish, he may find his power of flight regained. On one occasion a solan was seen to disgorge no fewer than seven mackerel.



An immature Solan Goose—in its second season. From its first perilous flight, it has been entirely forgotten by its parents, but it soon makes the discovery that air and water are not unpleasant elements.

Now a mackerel is probably, on an average, almost a pound in weight, so from this the voracity of a gannet may be realized.

The solan when fishing flies at a considerable height (perhaps 100 feet) above the sea. On sighting a fish he swerves suddenly in his flight, and descends to the water without hesitation. His wings remain open until he is in the act of entering the sea, so that in his downward " stoop " a gannet is unlike a golden eagle or a peregrine falcon —for both these birds when rushing earthward have the wings tightly closed. A solan goose enters the water at great speed,* and he must descend to considerable depths. The fish—be it a herring or mackerel—is, so far as my experience goes, invariably swallowed beneath the surface, and after an interval the gannet appears once more. His buoyancy on reaching the surface is such that he literally shoots out of the water, and almost at once rises to resume his fishing.

Although the gannet penetrates far inland by way of the larger sea-lochs, he shows a curious reluctance to fly over land. Indeed, there is only one place where I have seen the birds do this—in Harris. Here, between West and East Loch Tarbert, is a narrow neck of land, and this the solans from time to time cross when flying from the Minch to the Atlantic.

In their breeding places gannets are most conservative; they nest in great colonies, but their nesting rocks are few and far apart. At the Bass Rock the advance guard of the great company arrives during the last days of January. They are more wary by far than later on in the season, and if approached take flight in a body. Likewise in late autumn; they may still linger at the Bass even in November, but they are nervous and easily scared. The nesting ledges become very dirty towards the end of the season, and half-digested fish lying around do not tend to improve matters.

The feeding of the young solan by the parent is seldom observed. It takes place usually during the first hours of daylight. For some time before it is heeded the youngster taps upon the parent's bill. At length the old gannet opens her mouth wide. The offspring thereupon inserts the whole of its head down its parent's capacious gullet, and there receives the entire though half-digested fish for its breakfast.

When alarmed the young gannets with-

* The gannet, like the golden eagle, has a strong third eyelid or nictitating membrane. This very possibly protects the bird at the moment of his quick impact with the water

out effort throw up these fish, but never, so far as my experience goes, do they make any attempt to swallow them again.

So plastered with guano are the nesting ledges that they appear snow-white, and I have seen them at an incredible distance. From the summit of Beinn Mhor, on the Hebridean Island of South Uist, I have seen through the glass the nesting ledges of the gannet colony upon St. Kilda, between fifty and sixty miles distant, showing white on the western horizon!

The instinct that guides the solan geese on their long flight over the sea has always seemed to me to be very wonderful. During these journeys they travel low—a foot or so above the water's surface—and thus their range of vision is restricted. But apart from this, it is only on days of rare visibility that land is in sight all the way from, let us say, the Island of Mull to St. Kilda. And yet the gannets are constantly making this journey. It is only during a time of thick fog that they appear not entirely certain of their bearings.

Curious positions assumed by Solan Geese when dropping against a breeze. Note the upturned tail and outspread feet.

Under such conditions I have seen them approach the western coast of the island of South Uist, almost reaching the land before they were aware of the fact. But their flight was never uncertain—they swept through the fog at their usual speed, and on seeing land swerved off and headed south.

The question arises: What is the average speed of a gannet's flight?

The answer to this is not easy, for days at sea when there is no breeze are very rare. But I should say that, on a windless day, a solan goose would progress at a speed of forty miles an hour. Actually, very much higher speeds are attained. With a favourable wind a gannet can with ease travel at the rate of a mile a minute, and with a following gale he can probably touch ninety to 100 miles an hour. There is no seabird which possesses such a power of forcing his way against a full gale. On days when the spindrift is being lifted off the ocean in white menacing clouds, when blinding squalls of rain and hail are driven on the arms of the gale, the gannet may often be seen forging his way in the teeth of the tempest. The gulls are being blown hither and thither, finding life on a day such as this most trying and unpleasant; even the fulmar petrels have not sufficient strength to face the gale. So the gannet has the sea to himself, and exults in his power of flight and of his mastery over the tempest.

12

# Why the Curlew has a long Bill

Photo: M. Best.

By C. S. BAYNE

THE curlew is at once one of our common and one of our most remarkable birds. Owing to his peculiar habits he is not so widely known as the robin and the thrush, but he is a familiar and welcome summer visitor to moorland and upland districts, and he spends the winter in flocks feeding at low tide on the muddy foreshores of our estuaries everywhere. His loud double call-note and his beautiful, though somewhat melancholy, trilling song are characteristic of the wilds he inhabits, and are so distinctive and striking that they compel attention whenever they are heard. Remarkable although they are, his form is still more so, and to a stranger who sees him close at hand for the first time is almost startling.

He is a large bird with the typical long legs of the waders, but his plumage is inconspicuous—chiefly pale brown marked with dark brown, a mixture that renders him almost invisible in his usual surroundings. But he has one feature that immediately arrests the eye and the mind of the observer, namely, his astonishing bill. It is six inches long—which is nearly a third of his total length—and is slender and almost rapier-like, except that it is curved downward towards the tip. With the eye it forms roughly an inverted query mark, and at once prompts the exclamation "Why?" Why should any bird be burdened with such an awkward and apparently such a vulnerable appendage? Is it a weapon of offence or defence? In tales of falconry there is more than one account of a heron that, when the hawk stooped, thrust up its long, sharp bill and received the enemy on the point; but such a manœuvre could hardly be successful for the curlew with his slim curved bill. In any case, however, spearing is only a subsidiary use for a bird's beak, the main purpose of which is the procuring of food. How, then, does his long slender curved bill assist the curlew?

The answer to this question is one of those little things that the average bird-book leaves to the imagination, and the solving of it cost me many hours of patient watching. Even then I obtained only a partial solution. I tried first on the moors at nesting time; but there the bird is so wary and so easily hidden among grass or heather that I found it impossible to observe it except at the nest or on the wing. Later, however, I had better fortune when I resorted to the mudflats in autumn and winter. There the curlews, as I have said, feed in flocks,

*Photo: Henry Willford.*

THE CURLEW: GUARDIAN OF THE MOOR.

Its most conspicuous feature is the slender curved bill which is six inches in length—a third of its total length.

*Photo: Alfred Taylor.*

The Curlew approaching the nest to cover the eggs. These are usually four in number, and olive green spotted with brown—a coloration which renders them wonderfully inconspicuous.

and it is comparatively simple to obtain a view of them across the wide stretches of flat, coverless ground. The difficulty is to get near enough to see what they are doing. It is useless to try and approach them across the mud, for they see you from afar and make off to a safe distance, alarming with their cries every other bird in the neighbourhood. The only chance is to find a comparatively narrow creek where they feed and where you can watch them from behind cover. After much searching I discovered such a place, and there I spent many days watching waders of various species at close enough quarters to observe all their activities with the naked eye, and twice I had the satisfaction of seeing a curlew putting the long bill to its full use.

For the most part these birds step about on the mud or in the pools in a very stately and dignified manner, picking up tit-bits daintily with the tip of the bill. Apparently they have the power of sucking the food up without any effort. At any rate, when the curlew takes hold of a small mollusc he does not have to throw back his head and allow the creature in its hard round shell to roll down the long passage into his throat, nor does he have to toss the shellfish into the air and then make a great gape to catch it. The captive disappears on its journey into the unknown as easily and as magically as do telegram cartons into the air tubes at the post-office.

After I had watched this mysterious process repeated without variation for some days, I came to the conclusion that the curlew's long bill is just a compensation for his tall legs, a substitute for a neck that would stretch far enough to save him from much bending. I had scarcely decided on this, when a bird that was feeding close to me suddenly thrust his bill down to its full length into the mud. I waited anxiously till he withdrew it again in the hope of seeing what kind of creature he took in this

*Photo: Alfred Taylor.*

The Curlew seen in the act of arranging her feet so that she can sit on the nest, which is a mere hollow in the ground lined with dead grass.

fashion, but either he had missed his prey altogether or it had disappeared in the approved manner while the bill was still ensheathed, for there was no sign of any victim between the mandibles when the tip of the bill was lifted clear of the mud. Several days later I watched another curlew probe in the same way repeatedly, and after every thrust he drew forth a large wriggling lug-worm which, after it had been carefully washed in a pool, vanished suddenly up the long tunnel. So besides compensating generally for the length of his legs, the curlew's bill serves also as a tool for extracting worms from the security of their burrows.

What still puzzles me, however, is the part played in the latter process by the curve of the bill. Another species of wader, the avocet, now one of our rare birds, though formerly he bred in the eastern counties, has an even more remarkable curve in his bill. Towards the point this long beak becomes very slim, and curls upwards like a well-waxed moustache. The impression it gives at first sight is that it is deformed, for obviously its owner cannot make a living in the usual bird manner by picking up his food between the tips of the two mandibles. The purpose of the bend becomes obvious when the bird is actually seen feeding. Standing at the edge of a pool he lowers his head and sweeps his bill from side to side through the water as if he were wielding a scythe, and as he does so he captures minute creatures swimming about or hiding among the mud or sand at the bottom. Clearly by this method he can obtain a meal more quickly than he could by making a separate grab at each darting tit-bit ; or by dibbling only when the hidden succulence sent up some unmistakable sign of its existence.

Again, the snipe, another member of the same family, has a long bill which is perfectly straight. His head, however, is so poised that he can stand right over a burrow and strike perpendicularly down into it. The tip of the upper mandible is flexible, so that it can be raised independently of the rest of the bill and can thus grip the unlucky worm. This method of dibbling is so effective that, though I have watched snipe feeding for hours on end, I have never seen one withdraw its bill without a victim. In the evolution of this process the skull of the bird has been profoundly modified. A simple example of this is the fact that the ear is placed under the eye, instead of behind it as in other birds.

The curlew has not become specialized for dibbling in this efficient manner. Even if he could make a straight downward thrust like the snipe, the curve of his bill would defeat his purpose, but I have never seen him attempt it. As he undoubtedly captures worms by probing, and in my experience he has invariably driven his bill to its full extent into the mud, I am left wondering whether, instead of making a direct attack through the entrance of the burrow, he begins his drill beyond it and, by his curved bill, breaks into it obliquely from below, thus catching the worm by the middle or by the tail.

*Photo : Henry Willford.*

This apparently awkward position of a Curlew astride her eggs shows the adjustment of the long legs just before she sits down.

The curlew, as I have said, nests on the

*Photo: Alfred Taylor.*

When, in the strength of her maternal pride, the Curlew is brooding, her mate keeps watch some distance away.

moors or in marshy parts of upland pastures, and it is in such places that his beautiful song is to be heard at its best. During April and May when a pair have occupied their nesting territory, and while the nest is being prepared and the eggs laid and incubated, the male frequently springs from the ground and, mounting with rapid wing-beats some forty or fifty feet into the air, hovers for a little while he begins slowly to trill his mellow flute-like notes. Then, holding his wings outspread and steady, he glides gently downwards, quickening the trill as he descends, and finally, as he nears the ground, allowing it to trail off into a long, melancholy and yet exquisitely pleasing wail. This note may be heard also on the mudflats in winter. Then it is not uttered while the bird is hovering or gliding, but while it is feeding, and often while it skims along close to the ground from one likely spot to another more promising a few yards off. The winter song is not nearly so long sustained as the spring song; it is subdued and soothingly suggestive of happy contentment. In spring it is loud, wild, and joyful in spite of its haunting melancholy strain. The bird's usual call in spring consists of two resounding notes, which might be rendered as *whoo-ee*, the voice rising on the second note. In winter this becomes quieter and is repeated more quickly, thus *whoy-whoy*. The bird also has several other notes expressive of alarm, warning, fear and pleasure.

The curlew's nest is just a hollow in the ground lined with dead grass. As a rule four eggs are laid, at intervals of two or three days. They are large, but as their colouring is olive green spotted with brown they are wonderfully inconspicuous, even at close quarters. I found my first curlew's nest by accident, and if the bird had not risen almost at my feet I should have passed it by. It is unusual for a curlew to sit so close, for it is a very wary bird; when one is brooding the other is watching some distance away, and at the approach of danger rises and gives the warning call. The result is that the hunter's eye is caught by it, and meanwhile the sitting bird quietly leaves the nest, runs a little way and flies up in another direction.

When the young are hatched they remain in the nest for a couple of days, but if danger threatens they will scatter and squat among the heather where the colouring of their down, dirty white with brown markings, renders them almost invisible. They are astonishingly unlike their parents, for though they have long legs their bills are short and straight. So at first they require a special diet, which consists almost entirely of insects, especially in the grub stage. Both parents are very attentive to them, moving about in company with them and instructing them in the art of finding grubs; when

*Photo: Alfred Taylor.*

Crouching close on the nest, the Curlew displays one use of her long curved bill in turning the eggs.

after about a month their bills have grown to the adult length and form, and their wings have become strong enough for flight,

*Photo: Alfred Taylor.*

A Curlew Chick is astonishingly unlike its parents, not only in its coloration but in the fact that its bill is short and straight.

the parents lead them off to the nearest marsh, and there demonstrate to them the still more important and difficult art of extracting worms from the mud.

The curlews during their summer sojourn on the moors enjoy a complete change of diet. They have earthworms, grubs, and land or freshwater snails instead of the creatures of the foreshore; besides these, they indulge in many a feast of berries, chiefly crowberries and blaeberries or bilberries, which are so plentiful on the moors.

Towards the end of July the various families gather into flocks and make for the estuaries where they will spend the following winter. On all journeys of any distance these birds range themselves in well-ordered lines or in V formation.

When they reach their winter quarters the young birds have not only to accustom themselves to a fresh diet, but they must also adapt themselves to entirely new conditions. On the inland marshes they could feed as often as they liked and whenever it happened to please them, but on the mudflats their meals are regulated not by their own choice, but by the ever-changing tide. Consequently their periods of feeding and resting are never the same on two consecutive days, and there is a difference of some hours between the feeding time at the beginning and at the end of the week. Nevertheless the curlews, wherever they may be, always know when feeding time comes, or in other words, when the tide begins to ebb. When the tide flows in and drives them from their beloved mudflats they are forced to seek refuge elsewhere, and usually fly inland and sleep their exile away on some unfrequented pasture. As soon as the mud begins to appear again, they return to the shore.

During August and September large flocks of whimbrel arrive on our coasts on their way from the far north to winter quarters much farther south, and as they are just smaller editions of the curlew it is easy to confuse the two species. If the two are seen feeding together it is simple to distinguish them by their relative sizes. When seen separately it is much more difficult—then the only sure guide is the call note.

*Photo: Albert H. Henry Willford.*

A Curlew's nest and eggs showing eggs chipping previous to the emergence of the chicks.

All through the winter the thin plantation of Larch had borne the aspect of death—to some folk, an appearance common to all leafless woods.

# 4.—"WHEN ROSY PLUMELETS TUFT THE LARCH"

By EDWARD STEP, F.L.S.

With photographs by the Author

WE had been along the riverside, enjoying the sight of the tall alders with their branches hung with long red catkins, and then we took the meandering path up through the sloping copse, where we saw the first of the hordes of anemones that will soon be turning their backs to the wind. The path was fringed with gold, for the burnished stars of lesser celandine were out in thousands on either side. Just by our exit from the copse, too, in a tangle of last year's stalks and leaves, we found the unassuming moschatel with its quaint yellow-green knobs of five flowers set closely back to back. Small things to take note of, you may say, but they encouraged us to continue up the slopes towards the downs, for it was such a day of promise as Browning recalls :

*"Thou wilt remember one warm morn when Winter*
*Crept aged from the earth, and Spring's first breath*
*Blew soft from the moist hills."*

In the pollen-bearing or male flowers of the Larch, the stumpy buds break out into a rosette of brown chaffy scales, above which the crowded stamens push their way, and always turn downwards.

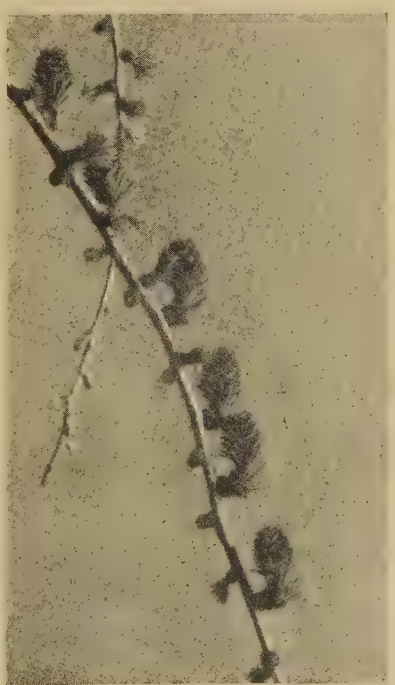
We turned into a "bottom" or combe of the chalk-hills, passing under a natural arch of old man's beard that was swung across the way from sapling beech to whitebeam; and another bit from Browning came to mind:

*"The woods were long austere with snow: at last*
*Pink leaflets budded on the beech, and fast*
*Larches, scattered through pine-tree solitudes,*
*Brightened."*

Yes; there was a thin plantation of larches ahead, which all through the winter had borne the aspect of death. To some folk, it is true, all leafless woods have this appearance; but in most woods, much green undergrowth, bright mosses and a few flowers greet the rambler all the winter. The pendent branchlets of the grey-barked larch are mostly embroidered with a filigree of grey lichens, which adds to their melancholy look.

But the winter of the larch in this country is a short one, and it is one of the first of the forest trees to decorate itself with the beauty of spring. The apparently dead, slender branches begin to bourgeon; the thick low buds that appeared lifeless burst open, some of them into clusters of pale-yellow stamens, others into egg-shaped cones with red-purple scales, and others again into brushes of bright-green needles. After a few days, when the brushes have spread into outward-curving circlets, the larch wood can hold its own in beauty. The pollen-bearing or male flowers are quite distinct in appearance from the cone-bearing or female flowers, and as a rule the two forms are borne on separate vertical branchlets of the same tree.

Reversing the order of the pine trees, where the female flowers are at the upper extremities of the shoots, the male flowers of the larch are usually higher on the branchlets than the females. Their stumpy buds break into a rosette of brown chaffy scales, above which the crowded stamens push their way and, splitting, pour out their abundant yellow pollen. There is no sign of green leaves about them, and they always turn downwards. The female buds, contrariwise, always turn upwards on their short footstalks; and first the separating coat of chaff reveals a circlet of short, bright-green needles. These are succeeded by the flower, which consists of about forty waxy-looking plates of an exquisite crimson, each with its pointed extremity turned out-



Contrariwise, the female buds of the Larch always turn upwards on their short footstalks, and first the separating coat of chaff reveals a circlet of short, bright-green needles.

Unlike the pine-cones, the Larch-cones have no knobs on their scales, and their edges are not cemented down. When fully grown—in their first autumn—they are only about an inch in length.

wards. This is what the observant Tennyson saw before he wrote :

> "*When rosy plumelets tuft the larch*
> *And rarely sings the mounted thrush.*"

The mistake is made sometimes of supposing that these waxy leaves become the hard woody brown scales of the larch cone ; but this is not correct, and a truer knowledge of the flower will come to us if with a keen blade we divide one of them from tip to base. It will be seen then that on the inner face of the waxen plate there lies a smaller, thinner scale which bears two ovules or seed-eggs.

The strong spring winds blow the pollen grains off the male flowers, but as these are heavy and not provided with air-bladders to render them buoyant (such as we find in the pollen of the pines), they do not travel far and they sink as they go. Some of them drop into the female flowers of neighbouring larches ; and it is evident that the turned-out tips of the waxy plates facilitate this process. Here they come into contact with the ovules and fertilize them. From the fact that the male flowers are, as a rule, situated higher than the females, the pollen grains might drop quite easily into the female flowers of the same tree, and it would be a fair inference to suppose that this is the explanation of their relative positions. Should a solitary larch, far way from any of its fellows, perhaps with pines in between, be observed, it will in all probability be found that, though in spring it bears flowers of both sorts in abundance, in autumn there is not a fertile cone upon it. This points to the fact that the ovules need to be cross-pollinated—that is, by pollen from another larch tree—in order that they may develop into fertile seeds.

As a result of this cross-fertilization the waxy plates shrivel and disappear, and the inner scales, bearing the minute seeds, enlarge. They are different from the vanished parts, for they are thin and hard, with broad, rounded tips, which are not turned down, woody in texture, pale brown in colour. Unlike the pine-cones, the larch-cones have no knobs on their scales, and their edges are not cemented down. When fully grown they are only about an inch in length. Again unlike the pine-cone, which requires two seasons for its growth and the ripening of its seeds, those of the larch are ripe in their first autumn, though they will be found mostly waiting in the cones until the March following, when the dry winds will pick them out and carry them away from the parent tree. Each seed has attached to it a stiff but thin plane which enables it to glide out upon the wind. Cutting one of the ripe cones down through the middle, it will be seen that the scales are outgrowths from a hard tapering core, upon which they are arranged spirally.

The leaves, which begin to appear at the same time as the flowers, are produced in brush-like tufts, but as they increase in

length they curve out from the centre and form thin rosettes. They are very slender, flat, of a light-green tint, and lack the stiffness of pine-needles. Towards the tips of the long shoots they are produced singly and follow more the direction of the shoot. In autumn they turn yellow before dropping off and leaving the tree leafless. In this matter the larch differs from all other coniferous trees, which retain their leaves for two or more years and so are clothed at all seasons.

As commonly grown in this country, the larch trees are packed closely in straight lines in plantations, so that none but the outer rows have a chance of developing their branches, and these only on one side of the tree. The object of the forester, of course, is to get tall straight trunks of uniform size to serve as poles; but the natural form of the tree is lost. To get a true idea of this we must seek out a specimen tree that has been planted on a lawn or in some similar open area, where we shall find it taking a graceful pyramidal form tapering up to a long slender point. The light branches extend equally all round, the upper ones horizontal, the lower with a downward sweep, then curving upwards at their extremities. From the branches hang side-shoots of considerable length, bearing the circlets of light-green needles and the always upright cones.

This pyramidal form points to the fact that the larch must have an abundance of light; this arrangement of the branches enables all the foliage to get its share. Naturally a tree of rapid growth, its rate of increase is accelerated by close packing

A branchlet of the Larch showing an old cone, new shoots, and female flowers. The leaves, which begin to appear at the same time as the flowers, are produced in brush-like tufts.

Larch Boletus (*Boletus laricinus*), an edible fungus, is found only in the immediate neighbourhood of Larch trees in autumn. Its slimy cap is two or three inches across.

in plantations, and its trunk kept perfectly straight and available for use as mast, scaffold-pole, telegraph-pole, etc. It is the only timber tree of which the present writer can say that he has witnessed the making of a plantation from seedlings, watched its rapid growth to stout serviceable timber, and the land cleared again. In Great Britain, if permitted, it will attain a height of sixty to eighty feet, but in favourable situations on the mountain slopes of Central Europe it grows to 120 feet or more, and it has been recorded as reaching 160 feet.

The bole spreads at the base and is covered with thick brown or reddish-grey bark with deep vertical fissures, a coat that enables it to endure intense cold, such as it must experience at an elevation of over 7,000 feet in the Swiss Alps. The mountains of Central Europe are its proper home; it is not found as a native tree in any part of the British Islands, to which it was introduced about three hundred years ago. The larch has been grown here so extensively, that in many places it is as familiar to us as most of our native trees. The acclimatization has not been attended altogether by success, as our home-grown larch timber is not so sound as the imported article. This inferiority is attributed by the forestry experts to the fact that British winters are either too brief or too mild to permit of the full development of the wood, and plantations often suffer severely from larch canker. This is caused by a fungus which shows itself externally in the form of minute cups one-sixth of an inch across, white and downy on the outside and bright orange within. Specimens may be found in any larch plantation. Its attacks are believed to be restricted to trees rendered sickly by the depredations of various insects, chiefly by the caterpillars of a tiny moth which mine the leaves and render them useless. The caterpillar of another small moth (*Argyresthia atmoriella*) destroys the leading shoot of the tree, and with it the straightness and symmetry of the trunk. Certain sawfly larvæ, too, will strip every leaf from the branches, and the grubs of the horntail wasp (*Sirex*) live for several years in the timber of sickly trees. The latter apparently do little damage, for they attack so small an area that the timber may be sawn up and used for building purposes without the presence of the insect being observed until the wasp emerges a few years later.

The Greater Horntail Wasp (*Sirex gigus*) deposits its grubs in the timber of sickly Larches. These apparently do little damage, although the larvæ may live for several years in the wood.

A B C

The three types of blooms (or heads of flowers) in the compositæ family. A.—Wild Camomile (*Daisy type*) has strap-shaped florets for its white rays, and tubular florets massed in the centre. There are over 200 flowers in this one bloom. B.—The Dandelion is made up of strap-shaped florets only, and there are over 200 flowers in this bloom. C.—The Groundsel has tubular florets only, and there are about 70 flowers in each head.

# 4.—THE BIGGEST FAMILY IN THE WORLD

By G. CLARKE NUTTALL, B.Sc.

With photographs by the Author

SUCCESS is worth studying because it usually implies that the successful individuals have been specially clever in adapting themselves to their environment and in adapting also the conditions of that environment to their own advancement.

There is a certain family of plants that bears all the marks of success. It has an exceptionally large number of members and is practically ubiquitous. Representatives of the family are found alike flourishing in valleys, covering great plains and making a brave struggle for existence on the high mountains; they are equally at home on dreary waste lands and in fertile gardens; they cross continents and oceans, and no sort of climate seems to damp their ardour. In a word, it is the biggest and most successful family in the world, and therefore well worth our consideration.

Its family name is *Compositæ*, and its characteristics are well marked; among its members are many of our oldest and most intimate friends. There is the daisy, "the little children's flower," to which even Chaucer's "knights and dames their homage made," and to which, also, one of his ladies sang a virelay, the burthen of which was "the daisy is so sweet"; the dandelion, "golden kisses all over the cheek of the meadow"; the tall gay goldenrod; the fleabanes, whose appear-

In the Wild Camomile each bloom is a collection of 200 to 300 flowers, set in concentric rings. Each ray is a flower. In the centre of the illustration is seen the resulting head of dry fruit—one for each bloom.

ance is more attractive than their name; the golden samphire of the sea coast; "goldilocks," the little native representative of all the asters and Michaelmas daisies; the cudweeds, one of which our ancestors called the "impious flower," because its secondary shoots always grew to overtop the parent branch and thus unfilially "looked down upon it"; the fortune-telling ox-eye daisy, or marguerite, and the prolific feverfew, with their yellow centre and white rays; the all-yellow corn-marigold; the various camomiles of medical fame; the grey mugwort; the ragworts, usually of the gayest but including the dull groundsel; the tansy, reminiscent of "tea"; all the great company of thistles, including the carline and the Scotch; the perplexing commonplace crowd of hawkweeds, hawkbits and the like; the coltsfoot, whose blooms come as an advance guard of the flowers in the spring, and so greatly anticipate the leaves; the lettuces and sowthistles; and finally the beautiful blue chicory. There are others, too, of lesser or little interest—in fact, there are forty-one groups with just over a hundred different flowers, all members of this family, which are natives of this country.

In our gardens also many distinguished foreign relatives find an honoured place; among them the stately sunflowers, which Swinburne saw "ranged in royal rank arow along the warm grey wall," the "ardent marigolds" of Keats; the gorgeous chrysanthemums from the East; the cinerarias of heavenly hue; the dahlias, which always seem stiff and "Victorian"; the brilliant coreopsis; the handsome globe thistle and the Jerusalem artichoke from which cooks make their "Palestine soup." But what avails to begin a list which seems endless? It has been reckoned that in all there are over ten thousand plants belonging to this family. For the most part its members are herbs—certainly all those native to this land are—but a few foreigners, such as the daisy bushes of New Zealand, are shrubs.

When one comes to ask why this family of plants should be so successful, it is apparent at once that it is because throughout its whole range and in every particular it is characterized by thrift, ingenuity and adaptability. The thrift and ingenuity are chiefly shown in the way in which it deals with the problem of the reproduction of its race in its flowers. The flowers are individually small, often infini-

tesimally so, hence insignificant; but they are always massed together into "heads" or "blooms," so that by reason of their massing they can make a brave show with little expenditure on the brilliant advertising petals that other plants have to produce. Thus a daisy, which we loosely call a flower, is really a collection of two to three hundred flowers tightly packed together and set on the flattened end of a single stalk. And here comes in an interesting fact. In this family there are two kinds of flowers—in one kind the petals are joined to form a tiny tube, and the massed flowers make the yellow centre of the daisy and feverfew; in the other kind of flower the petals, though slightly rolled at the base, are joined in the shape of a flat strap, and these form the white rays of the same two blooms. In both kinds of flowers, when perfect, there are five stamens whose heads are joined together to form a cylinder and, below the petals, a very minute seed-case containing a single still more minute seed, from which a little column runs up the centre of the flower to the bottom of the stamen-head cylinder. Outside the petals, on the top of the seed-case, is a small calyx, which may be at first just a ring of hairs but, later, becomes of more importance.

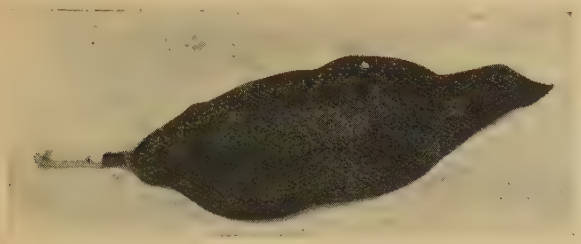
It is obvious that there can be three kinds of "blooms" or "heads"—the first where both kinds of flowers are found together, as already instanced in the daisy; the second, where a bloom is made up entirely of tubular flowers, as in the groundsel and the tansy; and the third, where it is composed solely of strap-shaped flowers, as in the dandelion. At the head of this article the three types of flowers are contrasted side by side. A characteristic bit of thriftiness is shown by the daisy and other blooms in which the strap-like flowers are used to form an attractive halo to the main body of

A spray of the Common Milfoil (or Yarrow), one of many on the same plant. This spray contains about 100 blooms, each of which is composite and made up of about eighteen florets. The central tubular florets are perfect, but the white ray florets (usually six) are female only. There are thus 1,800 flowers in this one spray, each producing a seed that may give rise to a new plant.

tubular flowers, in that the former flowers are incomplete, not being provided with stamens. The plants unconsciously argue that, as their special function is merely to be ornamental, there is no need to waste energy and material in filling them up with complete internal organs.

A typical bloom of the Sunflower, a member of the Compositæ family—daisy type. Hundreds of flowers are here massed in rings. The details of their development are shown in the lower photograph on the next page.

The mechanism by which a composite head carries out its purpose is rather intricate but most distinctly interesting. Look at a photograph of a bloom of the daisy type taken at near range. (A sunflower is chosen because the greater size makes observation possible to the naked eye.) The whole of the centre is obviously made up of a great number of concentric rings of tubular flowers. In the very centre are the youngest buds, so small and so tightly packed that one cannot count them. Then come larger and more definite buds as we pass outwards. (The successive stages now to be described are all set out in detail in the photograph on p. 249, and should be compared with the picture of the bloom as a whole. It should be noticed, too, that all the flowers in a ring act precisely together, like well-drilled soldiers.) Outside the big buds comes a ring of buds which have just opened and from which a small object, like a bayonet, protrudes. This is the cylinder of joined stamen-heads which has suddenly been pushed out. Each head contains floury pollen and, as it opens *on the inside* by a long slit, it allows the pollen to fall into the central space. It has already been said that the column from the seed-case reached the bottom of the cylinder and formed its floor, so that the pollen lies upon it. At this point the column itself quickly lengthens, pushing the pollen dust up before it, so that eventually it lies like a little white ball on the top of the stamen cylinder. This ring of white balls can be plainly seen in the photograph of the whole head. The rings immediately outside these balls are a stage further on still in development. In them the sweeping column has not only pushed through the pollen but has opened out like a fork—it is really remarkably like a sweep's broom appearing out of the top of a chimney—and it is now waiting for some fertilizing pollen to fall upon it. In any case this would be likely to happen in such close proximity, but it is facilitated by the multitude of little insects that visit these flower-heads and crawl all over them. It is remarkable how many come. The ragwort, for



A Ray floret. Note the white seed-case and the tiny tube at the base of the large flat ray formed by the union of the five petals.

instance, has been found to be visited by no fewer than fifty-two sorts of insects during its flowering, while the dandelion has a still bigger visiting list of ninety-five! These insects, attracted by the nectar in the flower, not only push the pollen balls from one ring of flowers on to another in the same bloom, but they bring on their bodies pollen from other blooms on other plants and thus ensure considerable cross-fertilization.

The pollen grains, having fallen on the stigma forks, promptly grow down the stigma column and merge with the infinites'mal seed in the case below, the stigma fork meanwhile withering and disappearing—(we are now at stage *g* in the photograph)—and the petals follow suit. In the flower depicted the seed swells and grows; but in the daisy and camomile, for instance, it always remains very small and the whole becomes a dried dead-looking object which ultimately breaks up and sets free between two and three hundred seeds—all potential new plants produced from the one bloom. When one remembers that there are a number of blooms on each plant—and there are myriads of plants in every flowery meadow—to contemplate the number of potential dais'es seeking new homes every season makes one positively dizzy! It has been computed that a single thistle in a single season could have a progeny of some 6,000 strong supposing the land could accommodate them.

In the dandelion, where all the florets are strap-shaped, precisely the same routine goes on; indeed, it is, with minor variations, identical in all plants of the family whichever type of bloom they affect.

After fertilization, however, there are many differences in the form of the seeds and the arrangements for their dispersal which provide interesting details for study. Thus in the dandelion when the bloom fades it folds up again, bud-like, while the little ring of hairs on the top of each seed-case is being carried up on a minute column to form a dainty parachute. At first it is folded, but one fine day there is a wonderful transformation scene. The enclosing bract-leaves yield and all the parachutes open together to form a beautiful "blow-ball." There are, of course, exactly as many parachutes carrying a seed as there were rays in the dandelion, one coming from each. The breeze blows, the light attachment of the seed to the flattened stalk-end gives, and by degrees they float away to destinies unknown. The last stage in the photograph (p. 251) shows how they are attached and how they take their flight. The groundsel, the hawkweeds, the ragworts all have similar feathery heads of fruits, but the prince of them all is that of "John-go-to-bed-at-noon" (*Tragopogon*). His "blowball" (p. 252) is far larger than that of the dandelion, and his parachute is quite the daintiest and most beautiful thing of the kind we have in Britain. The thistle favours a crown of feathery hairs rather than an

A Tubular Floret of Sunflower in all stages of development. (*a*, *b*) Buds. (*c*) Bud opening. (*d*) Stamen cylinder protruding. (*e*) Stigma brush appearing at top, having swept out the pollen. (*f*) Stigma brush open and waiting to be fertilized. (*g*) Fertilized and withering. (*h*, *i*, *j*) Development of seed.

The Thistle in fruit—a member of the Compositæ family, and perhaps the most successful of plants.

actual parachute. This thistledown starts off gaily carrying its seed burden, but tends to drop it at the first jar, though still itself floating on :—

*"Thistle beard,*
*That skimmed the surface of the dead calm lake,*
*Suddenly halting now—a lifeless stand!*
*And starting off again with freak as sudden,*
*In all its sportive wanderings, all the while*
*Making report of an invisible breeze*
*That was its wings, its chariot, and its horse,*
*Its playmate, rather say, its moving soul."*
—WORDSWORTH.

The members of this family never produce luscious fruit to appeal to the animal world, but the little dry seeds are beloved by many small birds, such as finches, who not only eat them but carry them about on their claws and feathers.

The members of the Compositæ clan are independent and self-reliant to the last degree—if their schemes for cross-fertilization go astray they can still fertilize themselves. They require no coddling and ask for no consideration; they are sturdy, hardy and unconquerable. They are of little or no economic use to man—indeed, they are more often a pest, worsting him in the race for the possession of land and taking advantage of the slightest neglect on his part. As Shakespeare said :

*"The even mead . . . . .*
*Wanting the scythe, all uncorrected, rank,*
*Conceives by idleness; and nothing teems*
*But hateful docks, rough thistles, kecksies, burs,*
*Losing both beauty and utility."*

But much more is this the case on virgin lands. Take the common creeping thistle, for instance, which made its appearance in the new countries of Canada and Manitoba, being probably imported with grain. (It is an unkind legend that says it was brought in by a Scotsman who wanted to plant it in his front garden!) It found there ideal conditions for the settlement of that immense army of offspring that may issue from a single plant in one season, and soon it began to swallow up the land and choke the crops; and though the farmers groaned, they

Feathery floating fruits (upper) of a Hawkweed; (lower) of a Thistle.

Fruit of the Dandelion: (left) the bloom, withered, folds up while the fruits are forming; (centre) the fruits being ripe, it has suddenly opened as a beautiful head of tiny seeds, each furnished with a parachute; (right) the wind having blown some away, the structure of the rest can be plainly seen, and also the manner of their attachment to the flat stalk-end.

Ragwort taking possession of a clearing in a pine-wood; in time it will oust most of the other plants.

Head of the Goatsbeard, or "John-go-to-bed-at-noon" (*Tragopogon*).

were individually helpless before its onslaught. For what avail to clear one's own land, if land in the neighbourhood still harboured it?—the clearing only encouraged new settlers. So the Legislative Assembly had to come to the rescue with a "Thistle Act" (1895), whereby every man, on being served with a notice, had to rid his land within fourteen days of all thistles, and, if he failed in this, Government officials stepped in and did it for him, not omitting to send him the bill; moreover the Government reserved the right to enter any man's land and inspect it for evidence of the pernicious weed, for it was a fight to the death. In Victoria and other parts of Australia the same difficulty had arisen, and here, too, a Thistle Preventive Act was necessary to ensure the co-operation of all in the elimination of the common foe; and the thistle has been checked in its mad career. But the expense and trouble involved have taught the Government a lesson, and now it is on the watch for possible troublesome immigrants among plants, as among men.

But the fight with weeds is a never-ending one; with the thistle, any cessation of vigilance, and there it is again; it is absolutely irrepressible, for was it not part of the curse on the earth, "thorns also and thistles shall it bring forth"? An instance of its irrepressibility and, incidentally, one illustrating a characteristic of the family as a whole, was given by an old botanist, who tells how he planted a piece about the size of a goosequill, two inches long, of the Canadian bugbear, the common creeping thistle. Six months later he had it dug up and found that some of the shoots were eight feet in length, while in place of the two-inch "goosequill" there were roots and shoots weighing four pounds! And he further goes on to say that in the following spring "this thistle again made its appearance on and about the place where the small thistle was originally planted. There were between fifty and sixty young heads, which must have sprung from the roots that had eluded the gardener's search, though he was particularly careful in extracting them." No wonder a family inherits the earth when it has members so tenacious of purpose as this! As a successful plant the thistle is the last word in hardiness, endurance, self-defence and happy co-operation, and it is entirely typical of the majority of individuals that make up the biggest family in the world.

The beautiful parachutes of "John-go-to-bed-at-noon" (*Tragopogon*).

In the Water Buttercup we have a species with showy flowers, and many of the characteristics associated with the typical land plant.

# 5.—THE STORY OF THE WATER BUTTERCUP

By S. LEONARD BASTIN

With photographs by the Author

THERE is little doubt that the first plants on this earth were aquatic in their habits. As time went on certain forms became fitted to live on land, and these were the forerunners of the great army of land plants which we see around us to-day. With the passage of the ages all kinds of changes and modifications occurred until, at last, the flowering seed plant arrived on the scene. This is to be regarded as the most advanced of all forms of vegetable life. Then, as the struggle for existence became severe amongst the land plants, not a few of the species returned to the water, where they probably have a much better time than if they had stayed on the soil. So that, at the present time we find certain flowering seed plants growing in our rivers, lakes and ponds, often crowding out the original aquatics to which the water more properly belongs. These flowering species have certainly not always been aquatics, for no plant would have evolved the seed habit whilst in the water; the flower is only a useful structure in the air.

One of the most interesting examples of these advanced plants which have returned to the water is the water buttercup (*Ranunculus aquatilis*). Here we have a species with showy flowers and very many of the characteristics which are associated with

the typical land plant. In fact, now and again, when a small pond dries up in the summer the water buttercup is able to persist, sending its roots deep into the mud until such time as the pool fills again.

The two leaf-forms of the Water Buttercup; the flat three-lobed leaves on the flowering stem, which mostly float on the surface of the water; and, quite distinct, the under-water foliage, in which each leaf is little more than a cluster of midribs and veins with a general appearance of so many green hairs.

Indeed, the plant is peculiarly fitted to make the best of both worlds. The flowering portion of the stem which rises above the water bears flat three-lobed leaves which mostly float on the surface of the water, although, when growth is very vigorous, they may stand up quite clear of the pool. Beneath the water the character of the foliage is quite distinct. Here each leaf is little more than a cluster of midribs and veins, giving a general appearance of so many green hairs. These submerged leaves grow best in swiftly running water. In such positions the plant becomes more definitely an aquatic and the pretty white flowers are not nearly so freely produced as when the buttercup is growing in stagnant waters. The plant on these occasions does not rely so much on seed production for propagation, but chiefly upon the broken stems which the stream carries to fresh situations lower down.

In almost any long portion of the stem of the water buttercup it is possible to see each stage in the transition from the air foliage to that which is submerged. Close to the flower heads there are three or four of the flat-lobed leaves; just below the water there will be organs which are partly flat and partly hair-like. Then at last one reaches the point where the entire foliage is "filiform" or thread-like. Certainly the water buttercup is one of the most interesting plants, from the evolutionary point of view, which occurs in the British Islands.

The thread-like leaf is widely found among water plants which belong to distinct orders. This is because it is so well suited to the part which it has to play. Water does not contain so much carbonic acid as the atmosphere, and this fact has led to the development of the filiform leaf. In the air above, where there is no shortage of carbonic acid gas, the leaves can expand to their fullest extent, but atmospheric food supplies are short in the water, hence the totally submerged foliage is reduced to a cluster of midribs and veins.

The water buttercup is a variable plant in the general manner of its growth. In a river the stems may be several feet in length, whilst in a shallow pond they are perhaps no more than a few inches. Several varieties have been regarded as definite species by botanists, although any one plant may evidence such a diversity in leaf formation that classification is difficult. The ivy-leaved crowfoot (*Ranunculus hederaceus*) is, however, easily recognized owing to the fact that it is always much smaller than the common species.

The pretty white flowers of the Water Buttercup are more freely produced when the plant is growing in stagnant waters.

# 2.—THE LIFE-STORY OF THE EEL

By F. MARTIN DUNCAN, F.R.M.S., F.R.P.S., F.Z.S.

With photographs by the Author

FROM the days of Aristotle down to the present century the birth and early life-history of our common eel (*Anguilla vulgaris*) remained an unsolved mystery. Many and varied have been the theories propounded by philosophers and laymen through the passing centuries as to the breeding of the eel; from the theory of a spontaneous generation, the outcome of putrefaction, to the production of eels by steeping horsehair, preferably from the body of a stallion, in a shallow pool! Even the identity of the sexes was not established until the latter half of the nineteenth century. A hundred years elapsed between the discovery of the female and the male eel, the former being first described by Mondini in 1777, and the latter by Syriski in 1874. Another twenty years elapsed before the Italian zoologists, Grassi and Calandruccio, published in 1896 their epoch-making discovery of the young or larval eel; but still the earliest stages, the period of time covered by the childhood of the eel and the actual breeding grounds, remained unknown. Now, however, after some sixteen or seventeen years of patient and untiring investigation, the great marine biologist, Dr. Johs. Schmidt, of Copenhagen, has at last solved the mystery and completed our knowledge of the entire life-history of the eel, a life-history that must for ever rank as one of the most intensely interesting and extraordinary in the whole realm of Nature.

The larva, or young (*Leptocephalus brevirostris*, literally "small head"), of the common eel of British ponds and rivers. At one time variations in shape, size, and structure, among the specimens, led to their being described as different species. Photographed at the length of 2½ centimetres.

The long period which elapsed between the actual discovery and demonstration of the sexes may be traced to three causes. Firstly because the male eel always remains nearer the sea, living chiefly in the brackish waters of the mouths and estuaries of rivers, rarely ascending far above the reach of tides. Secondly, because he is smaller than the female, seldom exceeding 17½ inches in length, and, possessing a broad head and snout, was therefore looked upon as a variety, if not a distinct species, known as the rig or broad-nosed eel. While thirdly, and this applies equally to both sexes, the sexual organs do not begin to mature or attain an easily recognized size until the eels have passed out to sea and are well on their way to their breeding grounds.

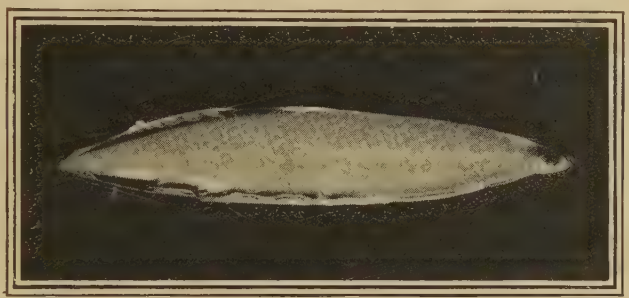
The female eel attains much greater size than the male; specimens well over three feet in length are occasionally captured. Because of her more pointed snout and narrower head the female is popularly known as a "sharp-nosed eel." The females are to be found in all rivers, and also in dykes, ponds and lakes far inland; they reach these isolated waters by travelling overland generally at night, when the herbage of the fields and meadows are damp with rain and

dew. The eels are able to accomplish such journeys by reason of the profuse slime secreted by the skin, and also by the beautiful mechanism of their gills, which enables them to retain in the gill-cavity sufficient water to keep the delicate folds or branchial laminæ afloat. In a live eel these gill-cavities appear as a conspicuous swelling on each side of the throat, and so long as they are filled with water the eel can remain on land without fear of suffocation.

As eels of all sizes are to be found at all seasons of the year in rivers, ponds and lakes, often far from the sea, it is not very surprising that the possibility of their real breeding ground being far out in the depths of the ocean remained long unsuspected, or that until comparatively recent times a vague but very general idea existed that a certain proportion bred in some mysterious way in the inland waters, and others in the sea.

Every autumn considerable numbers of eels begin to pass down the rivers towards the open sea, and there is a regular fishery carried on for these migrants. They are caught in wicker basket traps called "eel-bucks"; while farther north, in Denmark and Sweden, they are taken not only as they pass down the rivers, but even as they journey along the coasts, the traps being set from the margin of the shore outwards in shallow water down to a depth of about six fathoms. This annual autumn migration, however, is not composed of the whole eel population of the ponds, lakes and rivers, but is confined entirely to those individuals which have begun to feel the sexual impulse. Eels may remain in one district for many years; the period varies greatly according to sex, climate, and food supply, so that it may range from five to twenty years or longer before the sexual instinct calls them back to the sea. These years spent in the rivers and lakes are devoted to feeding and growth. During the whole of this time the eels are of a greenish or yellowish colour, and are known to fishermen as "yellow eels." Once the migratory instinct begins to assert itself, the eels cease to feed so voraciously, and their bodies take on a metallic sheen, while their pectoral fins become pointed and black in colour. In this, their migratory dress, they are known as "silver eels," their flesh is firm and rich in fat, and they are eagerly caught for the market. They have reached the zenith of their size and strength, and are in perfect condition to undertake the second great journey of their lives, back to their natural and only breeding grounds, far across the ocean, whence they will never return.

Just as every autumn this great migration of adult eels takes place seawards, so every spring sees the arrival of vast hosts of tiny eels or "elvers," which ascend the rivers from the sea all round our coasts. These elvers, or "eel-fare," as they are called in some counties, are slender, semi-transparent little creatures, measuring two or three inches in length. The elvers are greedily devoured by birds and fishes as they ascend the rivers in dense masses, and are also caught in hand nets, salted, and fried, to be sold as "elver cakes"; heavy toll, indeed, is taken of the multitudes which annually come up the rivers from the sea.



*Leptocephalus* larva of the common eel, photographed at the length of 4⅓ centimetres. These larvæ are transparent, measure some 4½ inches to 5 inches in length, and resemble in shape a willow or eucalyptus leaf.

Although so small and transparent, the elvers are otherwise fully developed, and have the same shaped body, head, and fins, and other characteristics of the adult eel. Because no one had ever seen an elver that was not a perfect eel in miniature, it was at one time thought that the young must hatch out from the egg more or less closely resembling the adult in appearance. But as the more accurate study of fishes began to reveal the fact that the majority undergo considerable changes in shape before taking on the characteristic form of the adult, grave doubts arose as to the probability of

the early life-history of the eel being quite so simple.

For the beginning of the story of our knowledge of the life-history of the eel, we must go back to the early 'fifties of the last century, when certain small, leaf-like, transparent fishes called *Leptocephali* (literally "small heads"), chiefly obtained from the Straits of Messina, began to attract considerable attention. One of the earliest accounts of these curious little fish, written by Kaup, appears in a British Museum catalogue published in 1856, in which twenty-two supposed species are described, and amongst them one called the *Leptocephalus brevirostris* was for the first time figured. These little fish present a very striking appearance, for they are transparent, have very small heads, measure some 4½ to 5 inches in length, and resemble in shape a willow or eucalyptus leaf. Differences in shape, size, and structure among the specimens led to their being described as different species, and various theories were propounded concerning their nature, one being that they were the larval stage of certain fishes related to the red band fish. An American naturalist, Theodore Gill, appears to have been the first rightly to suspect that they were really early larval forms of various species of eels, for in 1864 he expressed the following opinion on the subject: "I am almost certain that the typical *Leptocephali* are at least the young of congers, and that *Leptocephalus morrisii* is the young of the common conger eel (*Conger vulgaris*)." Gill's surmise was destined to be proved correct, and his opinion was upheld by Dr. Günther, of the British Museum, who, however, propounded the extraordinary theory that these little fishes were monstrosities, youngsters who, having by some unknown means got into unnatural conditions or unsuitable environment, had become Peter Pans of the fish world, and consequently could not grow up or pass through their proper transformations to the adult form! Finally, however, Professors Grassi and Calandruccio conclusively demonstrated that the little fish known to science for so many years as the *Leptocephalus brevirostris* was the true larva, or young, of the common eel. The investigations of these Italian naturalists were carried out in the Mediterranean, for they were able to obtain large numbers of the little *Leptocephali* in the Straits of Messina, where they are brought to the surface by the action of powerful whirlpools, which at certain seasons of the year there reveal various forms of marine creatures peculiar to the great depths of the ocean.

Every spring vast numbers of elvers, or young eels, ascend the British rivers from the sea. During the third autumn and winter of their lives they undergo the remarkable change which gives them their shape as elvers.

The identity of this early stage in the life-history of the eel having been established, the actual breeding grounds and early history still remained to be discovered. Patiently, through long years of untiring investigation, Dr. Johs. Schmidt has gathered material which at last has enabled him to discover and chart the actual spawning ground of the eel, and to trace its complete life-history

During the autumn and winter months the eels, clad in their silvery dress, migrate from the lakes and rivers of Great Britain, of north and west Europe, from the Baltic and the North Sea, and move out into the Atlantic. There they shape their course south-west through the ocean, with the same unerring instinct as migrating birds, following the same course as their ancestors have done for countless generations. How long that journey lasts is still uncertain, but by marking numbers of these migrating eels with small silver disks fastened to their dorsal fins — each disk bearing a distinctive mark and number — it has been possible to obtain much interesting information concerning the speed at which they start upon their long journey. These marking experiments were carried out in Sweden and Finland, and the marked eels recaptured at places lying nearer to the open sea. In every instance it was shown that they were heading for the North Sea and Atlantic Ocean. These experiments proved conclusively that considerable numbers of the migrating eels were travelling at a speed of at least 15 kilometres a day, and had maintained this speed for seventeen to thirty days before being recaptured. Once these migrating eels reach the open North Sea and Atlantic Ocean, however, they disappear from our ken, for the trawl and drifts nets of the fishing boats are unsuited for their capture.

When they have donned their migratory dress, eels are known as "silver eels," and their flesh is firm and rich in fat. At this stage they have reached the zenith of their size and strength.

As it was found impossible to follow the course of these adult migrating eels once they had passed out into the Atlantic, it was decided to attempt to trace the route by which the little *Leptocephali* or larval eels approach the coasts of north and west Europe, and so, if possible, to track them down to the unknown breeding ground. The task was by no means an easy one. Long cruises had to be made in ships more or less properly equipped with special apparatus for collecting these small fry, which swim at varying depths, from 50 to 25 metres, and at times even at the surface of the sea. Indeed, before sufficient data could be collected, voyages of investigation had been made ranging from America to Egypt, and from Iceland to the Canary Islands. But at long last the riddle was solved, and the breeding ground of all European and British eels—that is, the so-called " common eel " (*Anguilla vulgaris*)—was discovered to be a certain area situated in the western Atlantic, about 22° and 30° N. Lat., and about 48° and 65° W. Long., having its centre about equidistant from the Leeward Islands of the West Indies and Bermuda. There, spawning begins in early spring and lasts well on into the summer, and the tiny baby eels or *Leptocephali*, measuring 7-15 mm. in length, are found swimming at a depth of 200 to 300 metres from the surface, where the sea water has a temperature of about 20° C. The little creatures grow rapidly during the early months of their lives, and in their first summer attain an average length of 25 mm. They then quit the great depths in which they were

born and move up towards the surface waters, large numbers being taken at 50 and 25 metres, and even close to the surface.

Now, aided by the eastward movement of the surface waters, these little larval eels start upon their long journey across the ocean towards the shores of Europe ; a journey that will occupy the first three years of their existence. During their first summer they are in the western Atlantic, west of 50° long. W. The second summer finds them in the central Atlantic and grown to 50–55 mm. in length. In the third summer they arrive off the coastal banks of Europe, and though still retaining their compressed, leaf-shaped larval form, are full grown and average about 75 mm. in length. During this third autumn and winter of their lives they undergo the remarkable change or retrograde metamorphosis, which gives them their shape as tiny transparent eels ; it is now that they move inshore and make their way as " elvers," in countless numbers up the rivers and streams, and find their way far inland into ditches, ponds and lakes.

In working out this wonderful life-history, Dr. Schmidt made another curious and interesting discovery, namely, that the breeding ground of the American eel (*Anguilla rostrata*) is in close proximity to that of the European. In fact, he discovered that there are extensive areas where the larvæ of the two species are found living together in considerable numbers. Yet, despite this mingling in their early childhood, the two species later separate and depart to their respective continents ; no American eel has ever reached the shores of Europe, and no European eel has entered an American river. The natural factors responsible for this sorting out of the two species are full of interest. The breeding ground of the American eel has its centre of production somewhat farther west and south of that of the European eel ; while what we may term the early childhood of the American species—that is, the larval stages spent near the surface waters of the ocean—is of much shorter duration, only occupying about one year, and consequently too short a period of time in which to make the long journey across the ocean to the shores of Europe. Therefore, these precocious American eels must perforce seek a nearer landfall, and do indeed make at once towards the shores of America and the West Indies. The European eels, on the other hand, taking nearly three times as long over their larval stage development have, with the help of the ocean currents and their own active movements, travelled far from the western part of the Atlantic, where they were born, by the time they are ready as tiny elvers to seek the coastal waters of Europe and the British Isles, and to ascend the rivers.

Scales from body of an adult eel, greatly magnified. Note the bands showing seasonal growth.

The Smooth Snake, although said to be common in Dorset, Hampshire, Surrey or Berks, is really rare. Its temper is uncertain; even when thought friendly and tame, it will bite.

# 2.—HARMLESS SNAKES IN GREAT BRITAIN

## The Rare Smooth Snake and the Common Grass Snake

By P. CHALMERS MITCHELL, M.A., D.Sc., LL.D., F.R.S., C.B.E.

I WONDER why the smooth snake (*Coronella austriaca*) bites. I have never myself been able to find one in Dorset, Hampshire, Surrey or Berks, the few English counties in which it is said to be common; but I have often seen it in the South of France or in the London Zoo, and there is no doubt about its biting. It is really rather a cross snake, always ready to bite even when you think it has grown friendly and tame. The adder when attacked coils itself in a spring-like spiral disk, the head raised in the middle, poised and ready to strike. The smooth snake noses you in a slow and almost friendly way, but suddenly, without warning, chooses a suitable place deliberately, say one of your fingers, takes it into its mouth and almost chews, holding on firmly, and gradually pressing its teeth in. The bite has no venom and is little more than a sharp pinch, hardly ever drawing blood.

Probably it is almost a mechanical habit applied to man without any real intention of biting or hurting. The smooth snake prefers lizards to any other food. It is accustomed to glide among them, neither alarming them nor apparently paying any attention to them, until suddenly it seizes one of the active, wriggling little creatures, holds on firmly to it until it can throw its coils over the struggling animal, slowly smothering it, and not trying to swallow it until it is dead. It treats a mouse in the same way, a very different procedure from that of a poisonous snake.

*Photo: W. S. Berridge, F.Z.S.*

The Smooth Snake is similar to the Adder in size and shape, although the latter is stouter and has a broader head. Both frequent the same kind of places—dry and sunny spots—and avoid the damp and lush grass which Grass Snakes love.

A viper strikes almost instantaneously, and then lets go, partly as if it feared that the struggles of the dying animal might injure its delicate poison fangs, partly as if it knew that there was no need to take any further trouble as the venom would speedily conquer the victim. Big constricting snakes, like the boas and pythons, are also biters: they seize hold of their prey with their teeth, and grip it until they can surround its body with their coils.

It must be admitted, however, that there is a good deal of excuse for mistaking this rare snake for an adder. They frequent the same kind of places, both preferring dry and sunny spots. Although they must not be too far from water, they avoid the damp and lush grass which grass snakes love. They are about the same size as adders, from eighteen inches to two feet, whilst the grass snake is often much longer. The shape is rather similar, although the adder is stouter and more heavily built and has a broader head. But the smooth snake has the curious habit of swelling out the back of its mouth cavity, giving its head something of the triangular shape of that of an adder—perhaps to be connected with the power of a foreign relative, *Dasypeltis* of tropical Africa, which is able to swallow a hen's egg several times the thickness of its own head.

Close inspection shows that the scales of the smooth snake are smooth, without the little keel which marks those of the adder, and that its pupil is round, not a vertical slit as in the adder; but these minute although important differences cannot be seen until the snake has been caught or killed.

There is an equal difficulty about the colouring. The adder ought to be a brilliant, almost black-and-white creature with a clearly marked diamond pattern along the back. The smooth snake ought to have a silvery sheen, like polished steel, with little spots arranged in rows. Both are very variable, and both are often so dimly coloured that the pattern cannot be made out at a distance. Smooth snakes are generally dark greyish above with a red shade and red-brown spots; the under-surface is also dark greyish with less red, and is often specked with black and white.

Smooth snakes, also like adders, are viviparous, bringing forth a family of from six to ten, alive and wriggling, which have been hatched inside the body of the mother. They are nice snakes, harmless in every way, and there is no excuse for killing them. They are said to be increasing in numbers; but although for a good many years I have looked for them in one of the localities where they have often been taken—the fine range of dry sandy moors from Wareham towards

The eggs of the Grass Snake are whitish-yellow, about an inch long, soft, and rather sticky.

*Photos: M. H. Cranford.*

The Snake that laid the eggs shown above.

*Photo: W. S. Berridge, F.Z.S.*

As soon as the baby Grass Snakes emerge from the eggs they dash off on their own account. The parents seem to take no trouble either with the eggs or the young.

lighter, more sharply marked off from the sides than in the case of adders and smooth snakes, and is pale grey with black and white spots.

Grass snakes are the largest of British reptiles, about a yard being a common length, although monsters of four to five feet have been taken. They

Bere Regis in Dorset—I have never been fortunate. The Rev. O. Pickard Cambridge, a famous Dorset naturalist whose speciality was spiders, took a number near Bloxworth, and reports that they lived well and became quite tame, thriving on a meagre dietary of blow-flies and water.

No one has any excuse except ignorance and lack of observation to mistake the harmless ringed or grass snake for an adder or for any other creature. Yet I have often had sent me dead examples, sometimes from London suburban gardens, asking me to say what the dangerous serpent may be, and how it could possibly have got into such peaceful environments. The grass snakes of Great Britain can be recognized at once by the presence of a light collar round the neck, sometimes almost white, usually orange-yellow, continuous below, sloping upwards and backwards and divided by a dark line on the dorsal surface. Behind this there is usually a dark, almost black mark. The general colour of the body is olive-brown with small black spots and cross-bands. The under-surface seems much

are extremely fond of water, and in warm weather are often to be seen in shallow water, actively swimming in graceful horizontal folds. All snakes swim in that fashion, and not in vertical undulating folds. The imaginative persons who have seen and described the great sea-serpent have usually spoken of a vertical undulatory motion, so that if it does exist,

*Photo: M. H. Crawford.*

If handled gently, petted, and allowed to snuggle, the Grass Snake very soon becomes tame and loses its unpleasant habit of leaving a vile-smelling secretion on the hands.

the sea-serpent is probably not a serpent at all. The best explanation of the most conscientious descriptions of it seems to indicate that it was a large sea-lion swimming along the surface very rapidly. Those who have seen the sea-lions at the Zoo dashing across their pond after a fish will readily imagine how a mistake may have arisen.

Grass snakes spend the winter in the state of inactivity known as hibernation. All the pulses of their life are slowed down, and they lie dormant, sometimes several together under a heap of leaves and twigs in a dry hedgerow, deep in old manure heaps, under a haystack, or in some similar snug retreat, from early or late autumn, according to the weather and the locality, until spring. They climb trees, and once in a pollarded willow near Oxford I found one still active in a late but warm day of October ; perhaps it was in search of its winter quarters. When first cornered, smooth snakes are very frightened, dashing at you, hissing and making a great show of striking, although they never actually bite, nor indeed could their short teeth hurt if they did bite ; but if they are handled gently, petted and allowed to snuggle, they very soon become tame and lose their unpleasant habit of voiding an evil-smelling secretion on one's hands. They quickly begin to distinguish between persons, evincing affection for some and dislike to others. This choice is not altogether a matter of habit; it differs with individual snakes and individual persons. I had one grass snake that was never tame with me, although it was quite friendly with some other people who handled it for the first time. Several of my snakes, quite placid with me, were very cross with other people.

*Photo : Stanley Crook.*

The Grass Snake is the largest of British reptiles; usually it is about a yard in length, but specimens of four to five feet have been taken.

They are not easy to feed at first, but when they do feed they have wide tastes. Most of them seem to prefer small frogs to anything else. Some will take small mice, others will always refuse mice. Mealworms, earthworms, grubs of different kinds, sparrows' eggs, scraps of raw meat, and almost any kind of small fresh-water fish are all taken. They are said to eat newts and small toads, but none of mine, even when hungry and feeding well, ever took either of these. When they are kept as pets they should be

allowed plenty of liberty, taken out of their vivarium, and allowed to crawl about the room and to climb up on one. Above all, they should be given a moderately warm bath—not what we ourselves would call a warm bath, but water with the chill well off—and the bath should be large enough for them to swim in. In my rooms at Oxford my grass snakes used to be given a large sponge bath for half an hour once or twice a week, but an ordinary large bath with two or three inches of water, and no soap, is better.

In Great Britain the favourite food of grass snakes is certainly young frogs. It is when the tadpoles have turned into frogs and are hopping about in the lush grass near ditches or in water meadows that the snakes are most easy to find. They pair in May or June, and lay their eggs usually in early summer in manure heaps, rich soil, or heaps of decaying weed. The eggs are whitish yellow, about an inch long, soft, and rather sticky. From one to three dozen may be laid in the same place, so that they stick together almost as if glued. When the hatching time is near, about six to eight weeks after laying, the dark outline of the young snake can be seen wriggling inside the egg, and as soon as the baby snakes emerge they dash off on their own account. The young snakes are darker in colour than the adults. The parents seem to take no trouble either with the eggs or the young, and the babies have to forage for themselves, taking chiefly small insects.

The old-fashioned idea still lingers that animals must have some use—and by "use" is generally meant use to human beings. I am unable to give satisfaction to such selfish utilitarians in the case of the harmless snakes. Probably the country would get on quite well without them, and I have even heard it argued that as they take frogs, which in their turn are successful insect-traps, there is a balance against snakes in the economy of Nature. But it can be only a very small balance, and these snakes are so beautiful and so harmless in themselves that I hope every lover of wild creatures will do his best to protect them.

*Photo: John J. Ward, F.E.S.*

The Grass Snake (*Tropidonotus natrix*) folded up on an open bank in the sunshine.

# 6.—THE CUCKOO-SPIT AND THE FROG-HOPPER

By JOHN J. WARD, F.E.S.

Illustrated with original photographs by the Author

THE familiar, frothy masses seen adhering to the stems and leaves of plants during the spring and summer months, and commonly known as "cuckoo-spit," have, I need scarcely state, nothing whatever to do with the cuckoo.

Probably its name arose from the fact that the frothy substance begins to appear about the time that the cuckoo makes its advent; for in early times, when nature study was almost unknown, the rustic eye was often witness to strange phenomena which had to be accounted for, and since these spittle-like accumulations came with the cuckoo, what further proof could be needed?

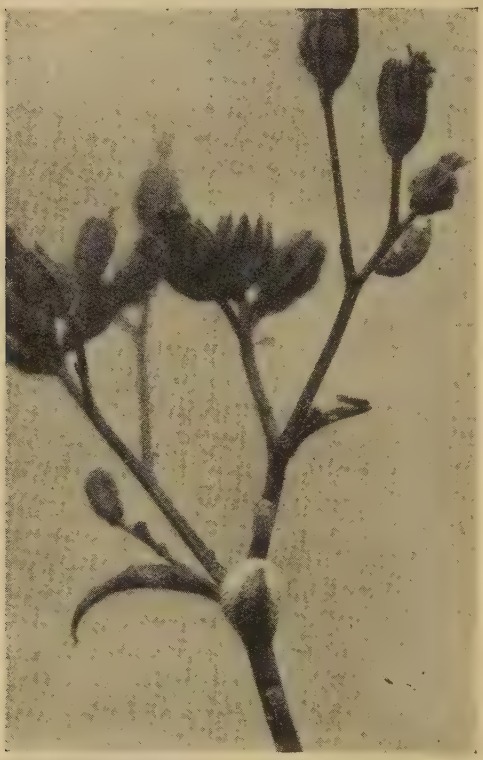
The Frog-hopper, which in its larval state makes the so-called "Cuckoo-spit."

Such hasty conclusions account for many of the common errors which lead man to harass the lives of harmless and interesting creatures of the countryside; dragon-flies are said to sting; toads to spit fire; newts to be dangerous and poisonous animals; shrew mice to be fearsome beasties, and so on.

Errors and superstitions of this order all arose from the same cause, namely, lack of observation. Some ignorant and scared individual would make a ridiculous statement, and, with the prevailing ignorance of those times, that statement would be readily exaggerated into something sinister and ill-omened. Even to-day, in country places, there are people who still believe that these frothy secretions are dropped on the plants by the cuckoo during its flight. Let us, then, apply the observation remedy in this case.

In my first photograph is shown an insect which, during the summer months, may be found amongst the plants in almost any garden, especially amongst the foliage of chrysanthemums. It is the frog-hopper (*Philænus spumarius*), a species of tree-bug. It derives its popular name from the somewhat superficial resemblance, which it bears when resting, to a miniature frog (the photograph well illustrates this characteristic), and the fact that it is provided with large and powerful hind-legs which enable it to make prodigious leaps.

When startled, without taking any run, it will sometimes jump from two to three feet. If a man were to make an equivalent jump he would have to leap from 250 to 350 yards. Its feet are provided with strong spines which assist its saltatorial movements, so that the insect gives a distinct click when it springs into space. It possesses a pair of flying wings covered with a membranous pair, somewhat like the elytra, or wing-cases, of a beetle; but it more



On the lower part of the stem a Frog-hopper larva, head downwards, is seen enveloping its body in the soapy froth, popularly known as "Cuckoo-spit." Above, on the right, another larva as it appeared at 10.30 a.m., also head downwards, is seen secreting at the end of its body the first spot of froth.

often prefers to use its jumping legs rather than its wings.

With this, then, insect begins the first stage of the "cuckoo-spit." During the late months of autumn it deposits and very skilfully hides its eggs; so skilfully does it hide them, indeed, that I am not aware that anyone has yet discovered where they are laid. I am inclined to think that they are placed, by means of a sharp ovipositor, into the tissues of plant stems near the surface of the ground. Two female insects, which were captured in November and enclosed in a glass fern case, and which ultimately died during the following month, did not appear to deposit any eggs, although a close watch was kept upon them. Nevertheless, the following April several of the ferns showed patches of cuckoo-spit, and as each patch of that foaming substance denotes an offspring of the frog-hopper, obviously the egg-laying problem was successfully negotiated even in the closed glass case.

The moment the larva appears it commences to feed, and is thenceforth "for ever blowing bubbles" until it completes its development. It is interesting, too, to observe its method of producing these soapy masses—for that is just what they are, nothing more or less; the little cuckoo-spit insect was probably the world's first soap-maker.

Just how the mass of "cuckoo-spit" comes into existence has never before, I think, been illustrated by means of a series of consecutive photographs. The accompanying set well illustrates the whole process.

On the lower part of the stem in the second photograph is seen a frog-hopper

The larvæ of the Frog-hopper, shown in the photograph above, as seen half an hour later (11 a.m.). The lower larva is now completely covered, but the upper one has yet to cover its head and fore-parts.

Half an hour later (11.30 a.m.) both larvæ were completely hidden in the soapy froth.

larva which has just begun to work. In a head-downwards position its body is being gradually enveloped in soapy bubbles. Near the top of the branch on the right is seen another larva, also head-downwards, which has just moulted its skin and found a suitable spot to feed and cover itself in bubbles. The photograph shows the two larvæ as they appeared at 10.30 a.m. on a July day.

Turning to the third photograph, made the same day at 11 a.m., we see that the lower larva has disappeared amongst the bubbles it has formed, while the upper one has also commenced to clothe its body with bubbles. It should be noticed that the bubbles are developing at the hind-part of the body, and that the head is the last part to be covered.

The latter point is important because it disposes of the common idea that the frothy covering is excessive sap sucked up by the insect's mouth-parts. The larva, having inserted its piercing implements into the plant tissues, proceeds to suck vigorously at its juices, and, after feeding for a short time, from a tube at the end of its body a spot of clear fluid is discharged, which gradually grows larger. This fluid has been shown to be a sugary sap which quickly ferments. When a fair-sized globule has formed the larva begins to churn it up by working the end of its body in and out of it; this action introduces air into the solution and makes it frothy. It is also thought to add a little wax, which it excretes from its skin.

This soapy mixture produced from the sweet sap, the ferment, the wax, and the air, continually increases in volume while it is agitated by the movements of the larva's body, until, half an hour later, it

Twenty-four hours later the upper larva had changed its feeding area to that of a lower branch, while the lower larva has remained in the same place. The object immediately above the lowest frothy mass is the cast skin of the larva, moulted before it began to feed. This skin may be seen in the upper photograph of this page and that preceding.

is completely enveloped—see photograph at top of p. 269.

In the next photograph are shown the same two larvæ as they apppeared twenty-four hours later. The lower one is seen to have remained at the same spot and increased its frothy covering, while the one on the upper branch has changed its feeding ground to a lower branch, leaving its old froth still on the upper branch.

In the midst of its soapy and translucent froth it rests and feeds, almost

Two days later the lower Frog-hopper has matured, and the frothy mass has dried up. The upper one is shown in the act of emerging; it has moulted its skin — which is left sticking in the soapy mass — and crawled clear of the froth on to the stem. The position of the camera is changed slightly to show the insect to better advantage.

immune from the attacks of its foes, as few enemies will penetrate its defence. There is, however, a particular species of wasp which enters the froth and drags out the larva, carrying it away to provision its nest; but, fortunately for the frog-hopper larva, that is a rare foe in the British Isles.

There is no caterpillar and quiescent chrysalis stage. The little larva slowly matures, moulting its skin from time to time, with each moult becoming more and more like the adult insect, until at last it is ready to make its final emergence. It then quietly crawls to the edge of its frothy covering, and, stepping out from it, leaves its last skin behind sticking amongst the froth—as shown in the final photograph.

It is then the possessor of a pair of wings with horny covers and powerful hind-legs, and is immediately able to perform its rapid leaps into space. No longer does it need a lather of soap solution to keep it cool and moist and protect it from its enemies, its newly-acquired wings, and more particularly its strong jumping legs, well serve those respective functions. Its business now is to find a mate in the bright sunlight, and later on, as autumn advances, to select a site for its eggs out of reach of man and other enemies.

On the outskirts of woods particularly large patches of "cuckoo-spit" may sometimes be found, these being produced by the larva of another frog-hopper (*Cercopis sanguinolenta*), a species about double the size of the common form, with wing-covers coloured a deep blue-black with heavy blotches of brilliant scarlet. It is very local and erratic in its appearance; some seasons it may be abundant in a district, and then will disappear perhaps for several years.

This scarlet hopper, as it is popularly called, is extremely active in its movements, and requires a careful approach to effect its capture. It is the handsomest insect amongst British plant bugs; and when seen during the breeding season congregated in numbers on the stems of low-growing plants, they give the effect of brilliantly coloured flowers.

The frog-hoppers belong to the *Homoptera* order of insects, which includes the green-fly, or aphides, often too familiar on the rose-buds in our gardens. They are characterized by tubular, piercing mouth-parts, perfectly adapted for penetrating the tissues of plants and for sucking their juices.

*Photo: Hugh Main, B.Sc., F.E.S*

An immature Field Cricket (natural size) before the wings are developed. The wings are of no use for flight.

# 7.—AN INSECT MUSICIAN: THE FIELD CRICKET

By K. G. BLAIR, B.Sc., F.E.S.

PERHAPS even to mankind a somewhat doubtful blessing, the advance of civilization, with the reclamation of waste-land and the clearing of woods that follows in its wake, is to many of our native birds and beasts and insects a very serious menace, and indeed in many instances has already brought about their practical extinction in Britain. Among the insects that are so threatened, insects that from old accounts appear to have been not uncommon, is the field-cricket (*Gryllus campestris*). Gilbert White, in his *Natural History of Selborne*, writes of it as "frequent in those parts," and "abundant" in a steep pasture-field consisting of a dry rocky soil (in just such a situation the present writer has found it in southern France), but for the last twenty years there does not appear to be a single British record of its capture.

The loss from our native fauna of an insect, even of one that may become a pest of agriculture, must always be for the nature-lover a matter for regret, but when it is the case of one against which no such charge seems to have been brought, and particularly of such a fine and self-assertive species as the field-cricket, one whose music forms so pleasant and striking a feature of the sunny days of early summer, its loss becomes deplorable.

A relative of the commoner, yet unfortunately also becoming scarcer, house-cricket, the "cricket on the hearth" (*Gryllus domesticus*), the field-cricket is larger and proportionately much more stoutly built. It is of a shining black colour with, in the male, a yellow bar across the base of the wing-covers. Its habits, too, differ in many respects; it keeps usually to the rough uncultivated fields, though it is sometimes

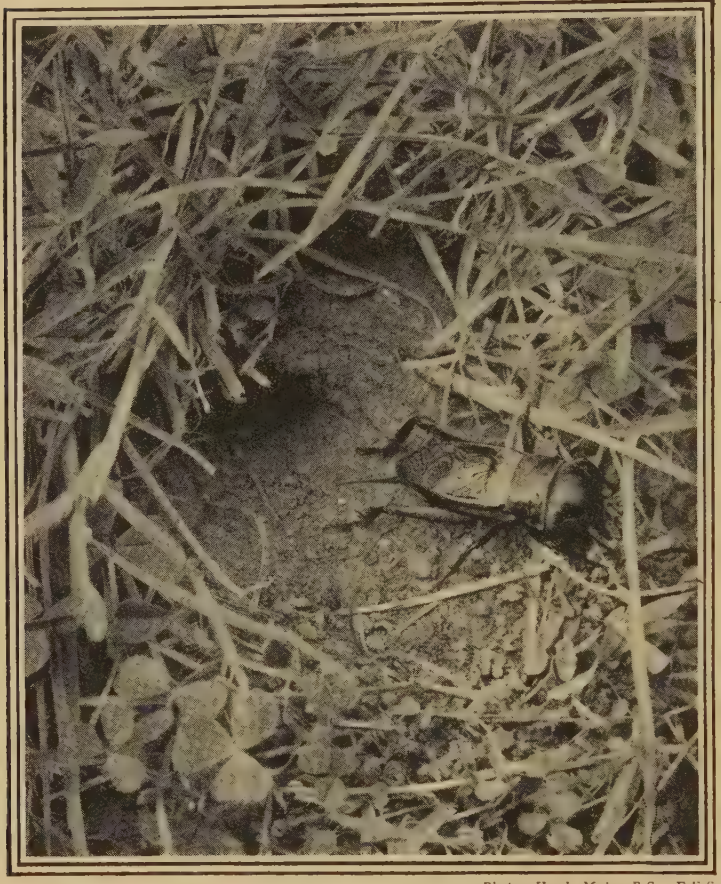


*Photo: Hugh Main, B.Sc., F.E.S.*

The Field Cricket delights to sit in the sunshine at the mouth of its burrow, where it chirrups away boldly until an approaching footstep warns it to retreat. This photograph shows the male insect in its natural size.

found on the sand dunes bordering the coast, and even on the shore itself. Instead of being nocturnal and shunning the light, it delights to sit in the sunshine at the mouth of its burrow, where it chirrups away boldly until an approaching footstep warns it to retreat. Then it retires quietly to the depths of its burrow to lie low till the coast is again clear. When it does wander at large it runs instead of jumps, and never flies—for the good reason that its wings remain undeveloped and incapable of flight. This aborted condition of the wings is no doubt to be accounted for by their lack of use in the course of many succeeding generations. This in turn is due probably to the massive build of the insect which renders it liable to painful shocks on alighting from flight, and possibly its habit of running instead of jumping is assignable to the same cause.

Though the wings themselves are of no use for flight, the wing-covers are well developed and form a very effective and very characteristic instrument in the equipment of the insect, but their purpose is not for flight. Even in those of its relatives, like the house-cricket, whose wings are developed as organs of flight, the wing-covers are not used for this purpose, or only in a minor degree, acting perhaps as planes to help maintain the heavy body in the air. The wing-covers of the crickets, at any rate in the males, form their musical apparatus, an instrument something in the nature of a violin and its bow.

If we examine the elytra or wing-covers of a field-cricket, or a house-cricket either for that matter, we shall note that each consists of a horizontal dorsal area that lies flat on the back, and a vertical lateral area that covers the side of the body. If the dorsal area exhibits a fairly regular series of raised lines or nervures that form a sort of diamond-shaped network, we may know that we have a female; this sex is further characterized by the long straight ovipositor projecting from the hinder end of the body. In the male, however, these nervures are arranged in an irregular manner, consisting mainly of a very strong depressed vein running across a little behind the base. From the inner end of this a straight vein runs obliquely across to the outer edge of

the dorsal area at about one-third of its length from the tip, dividing this area into roughly equal halves. If the wing-cover be turned up or removed, the underside of the transverse vein near the base will be seen to form a ridge across which, as examination with a strong lens reveals, run a large number of very fine teeth. This nervure we may consider as the bow.

At the inner end of this bow on the basal side of it will be seen a very small, almost semicircular, clear area in the surrounding blackish colour, the straight edge of which is apparently marginal. This edge is really a fine but hard and sharp nervure, which, or rather its fellow on the other wing-cover, forms the string of the violin. As the fine teeth of the bow are passed across this string a vibration is set up in both parts of the instrument, which is communicated to the membrane of both wing-covers. When the insect performs the wing-covers are raised and slightly opened, so that one no longer completely overlaps the other. Thus a considerable space is formed, enclosed by the raised wing-covers, their vertical side-pieces, and the surface of the abdomen, the whole forming a kind of sounding box. Then the wing-covers are moved slightly in and out so that the bow plays across the string, and, the action being reciprocal, the string plays across the bow. At first the motion is tentative and intermittent, but as the performer gains confidence the wing-covers are raised more and the note becomes louder and more sustained. Should he become suspicious of danger the wing-covers are lowered again, and the volume of the sounding box is consequently reduced. In the field the effect of this is to reduce the sound, so that if the observer endeavours to stalk the performer, the sound appears ever to recede before him in a most puzzling manner.

It is curious to note that the two elytra appear to be exactly symmetrical ; each has its bow, each has its string. Even the peculiar bends and convolutions of the nervures appear to correspond exactly, so that one may conclude that when the performer gets tired, or should the teeth on one bow become worn out, he can merely put the other elytron uppermost, and he at once has a new instrument. But in nature it

*Photo : Hugh Main, B.Sc., F.E.S.*

The female Field Cricket (natural size) is distinguished by the regular series of raised lines or nervures that form a sort of diamond-shaped network over the dorsal area of the wings.

will be noticed that the right elytron is always uppermost, and it is the bow on this elytron that is always used. That this should be so roused the curiosity of the observant French naturalist, Jean Henri Fabre, and he tells us how he tried by forcibly reversing the position of the elytra to make the cricket use the bow of the left one, but without success. By an effort it would always bring

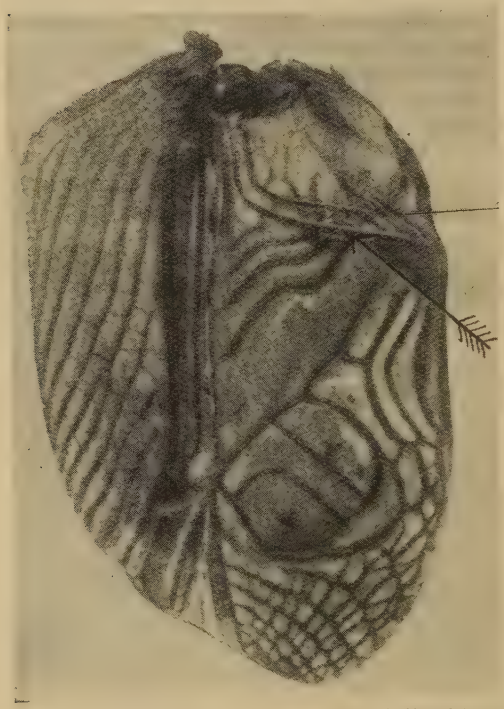



*Photo: A. Harold Bastin.*

The fore-wing of a Field Cricket (greatly magnified) seen from beneath, showing position of the file-like stridulating vein or nervure, which is rubbed across a prominent vein (*a*) on the wing lying beneath.

the right elytron again uppermost before commencing to play. He therefore concluded that certain muscles or sinews must have hardened in this position so that the instrument would no longer function when the elytra were reversed. He then conceived the idea of effecting the alteration in position when the insect had just attained the perfect state, while all its parts were still soft. With his usual patience he persevered until he found the insect in the right stage, and successfully performed the operation without injury to the delicate structures. Good! The subject did not reverse them, but matured with them in the desired position. At last it seemed about to begin to play, raised the elytra a little, but seemed not quite happy. Then with an obvious effort it changed their position, again bringing the right one uppermost. In the end Fabre had to leave the problem unsolved. Some of the long-horned grasshoppers have a somewhat similar instrument, and produce their note by rubbing one elytron over the other in the same way, but with them the left one comes uppermost, and the two elytra are dissimilar, so that the constancy of their position is readily intelligible. But with the crickets, Fabre was unable, even with a microscope, to find any difference of structure or any reason why one bow should always be used, and the other, apparently equally perfect, never. If the elytra of a dead cricket be moved, and the bow of one made to play across the string of the other, a feeble suggestion of the note is produced; if they be then reversed and the bow of the other made to play across the string of the first, the same sound is produced and the friction seems the same.

As we have seen, this remarkable instrument is possessed by the male cricket only; the female is quite silent. Theoretically, no doubt, its purpose is to charm his shy and retiring lady-love like a mediæval troubadour. In this respect we see a parallel between the insect and the bird, though I have a shrewd suspicion that the field-cricket, perhaps even more than the song thrush, sings very largely from the sheer joy of hearing his own music. Whether, like the troubadour, he wanders round to his lady-love's dwelling and invites her by his sweet playing to come out to him, or whether he plays always on his own doorstep and expects the lady to come and join him, I have been unable to discover. Certain it is that if one carefully stalks the little musician one may frequently see him retreat quietly and in good order down his own burrow, but if one then remains quiet he will soon come out again and proceed with the performance. Of course, it may be that on such occasions he is playing merely for his own pleasure and for the pure joy of life, but I have never had the good fortune to find him on a matrimonial

*Photo: A. Harold Bastin.*

Side view of the stridulating file or "bow" (greatly magnified) on the wing of the Field Cricket.

expedition. It would be interesting in such an event to observe his reception if he attempted to retreat into the lady's dwelling. Neither, on the other hand, have I ever discovered the approach of the lady to the gentleman's home, though I have on one occasion found both sexes in one burrow, and also found a male in the same burrow as an immature female.

A song or concert broadcasted by wireless or other means can, however, be appreciated by no one unless equipped with suitable apparatus for listening-in, so if the cricket's song is to serve any purpose, the audience for which it is intended must be equipped with hearing apparatus. Then the question arises, where are the cricket's ears? If we return to the subject whose wing-cases we examined, and this time look carefully at the fore-legs, we shall find near the base of the tibia, i.e. near the upper end of the middle section that rests nearly upright upon the ground, a pair of small oval white spaces, one on the outside of the leg and the other on the inside, the former being considerably the larger. Each of these white membranes covers a cavity in the leg, and is supposed to form the tympanum of the ear. This structure is found in both sexes, so that we must suppose that both can appreciate the music.

Though the musical effort of the cricket is perhaps its most striking feature, it possesses another characteristic which is very much more individual; this is the habit, already spoken of, of making for itself a burrow to serve as a domicile for its mature life.

The burrow is usually overhung by a tuft of grass or other low vegetation. In diameter it is a little too small for a finger to penetrate very far, and perhaps 4 to 9 inches in length, according to the nature of the soil. In front of it is to be seen a patch of bare earth, on which the cricket loves to sit in the sunshine, and which forms the platform on which the male sits to make music. The burrow itself is not lined in any way, though the walls are very carefully smoothed, and at the bottom its dimensions are slightly enlarged so that the occupant has just room to turn round. It is no hastily constructed retreat, but appears to be commenced by the young cricket when about half grown, at the beginning of winter, and to be at first merely the winter shelter. In the spring the young cricket seems to appreciate the advantage of this shelter as a permanent domicile, and spends much time in enlarging it and perfecting the smoothness of its walls, and here eventually it attains maturity. But full-grown or nearly full-grown crickets, though ready to avail them-

*Photo: A Harold Bastin.*

View from above of the stridulating file or "bow" (greatly magnified) on the fore-wing of the Field Cricket.

*Photo: Hugh Main, B.Sc., F.E.S.*

The egg of the Field Cricket is laid under the surface of the earth in the burrow. It is about 4 mm. in length, with rounded ends, and is of a yellow colour.

selves of shelter, apparently make no attempt to construct a new burrow for themselves.

And with what tools is this labour accomplished? Its relative, the mole cricket, has its fore-legs modified in a form that singularly recalls the fore-feet of its mammalian prototype, the mole, but the field-cricket is not so provided. It is probable, indeed, that the whole of the labour is performed by the jaws, and all the earth, small stones, etc., carried out morsel by morsel.

Whether in nature the eggs are laid in the open or in the burrow, I do not know, but in captivity they are deposited vertically in the earth about a quarter of an inch deep, usually singly, but sometimes two or three are found together, and not uncommonly a few are simply left on the surface of the earth. Each egg is somewhat cigar-shaped, long and narrow, about 4 mm. long by 1 mm. thick, with the ends rounded, and is of a yellow colour. When they hatch one end is pushed off like a lid, which usually does not become completely detached from the egg, and the young cricket escapes through the aperture. On first emerging it is white, but gradually turns darker, until it becomes black with a yellow band across a little behind the head. They are active little creatures and, unlike the parents, frequently take short leaps.

In form, the young very much resemble their parents, but, of course, are without the wings or elytra. These appear after a few moults as small outgrowths of the second and third thoracic segments, and increase in size with each successive moult. In these insects and their allies there is no resting stage corresponding to the chrysalis stage of a butterfly or moth, but after the last moult the wings attain their full size and the insect becomes mature.

*Photo: Hugh Main, B.Sc., F.E.S.*

When the egg is hatched one end is pushed off like a lid, which usually does not become completely detached, and the young cricket escapes through the aperture.

# 8.—WILES OF THE TIGER-BEETLE'S LARVA

By C. W. COLTHRUP, Z.P.C.

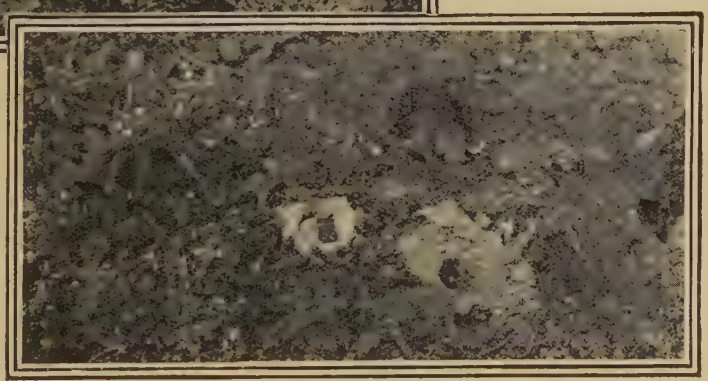
With photographs by the Author

NATURE'S freaks and fun, and the diversity of ways by which her children gain a livelihood, form for us humans a never-ending source of amusement and amazement.

The vertical pit dug by the Tiger-beetle Larva is used both as a house and a trap for his prey.

Here is the larva of the tiger-beetle (*Cicindela campestris*). To look at he might be thought a slothful, incompetent sort of creature; shapeless like all larvæ, fat, thin-skinned and short-legged. Like his parent—whose very name betokens ferocity—he is carnivorous, and prefers his food alive and kicking. But how, with this meagre equipment, is he to catch creatures such as ants, flies, or spiders—all armed and winged and fully legged, as they are? Where speed and strength are not to be reckoned on, one must needs have recourse to stratagem; and this is what this highly developed larva does.

Using his short, spiny legs as picks, and his head as a shovel, he excavates a vertical shaft some inches deep in a bank by the roadside. This is a "pit-fall" such as is used to this day by natives in the entrapping of wild animals. But unlike the human, Cicindela makes it his house as well, and at the base hollows out a snug retreat to sleep and eat in.



He does not wait for insects to tumble into his pit, but waits with his head blocking its entrance, and immediately an unsuspecting ant comes within reach, seizes it and drops to the bottom carrying his victim with him. The pit on the left of the photograph is blocked by the Cicindela.

However, even when this is done, ants and such folk do not come tumbling down any sort of open tunnel without due investigation—they are by no means so foolish. So, in the course of ages, our larva has evolved a means all of his own, whereby he can lie in wait, suspended at the top of his little tunnel, his head forming a camouflage which

completely hides the cavity below. He does this by means of two curious, curved hooks that grow out of the enlarged fifth segment of his body. Holding on to one side of the pit with these hooks he presses his tail against the other and hangs, awaiting developments. Presently, his unwary victim —ant, spider, caterpillar or fly, will come along, when with a quick movement, almost imperceptible to the human eye, he is seized by the larva.

This photograph shows the two pits opened up with the larva in position at the top of one.

At once—like the Jack-in-the-box reversed—the latter releases his hold on the pit-wall and drops with his victim into the home-dungeon. Henceforth struggle is useless, the prey has seen its last of the daylight, and the larva gorges contentedly.

Quite by himself, lying in wait, dropping instantaneously at the least sign of danger, climbing up and dropping again with a meal to devour, so this queer little creature spends its days, until the time comes for its metamorphosis. When the lassitude that precedes the change comes over him, he will stop up the mouth of his tunnel, curl himself up at the bottom, and in solitude and darkness await the transformation. So in due time he will reappear as a smart, green, fully formed tiger-beetle, as ferocious as in his former life, but in full possession of his limbs and faculties.

The female has powerful excavating organs on the end of her body with which she inserts her eggs in the ground. Both sexes now delight to career about in the spring sunshine, as much at home on a wind-swept down as in the quiet seclusion of a copse. With their six long and active legs, their sheathed wings and armoured bodies, they have no more need to resort to the excavating of pit-falls, but can go out on the war-path and meet their prey in the open.

*Photo: Frances Pitt.*

Picture a round, reddish-brown object, with a broad face and large shell-like ears; eyes like great liquid boot-buttons; a thick feathery tail—and you have the Dormouse.

# 5.—THE LITTLE SLEEPER IN THE HEDGEROW

By H. W. SHEPHEARD-WALWYN, M.A., F.R.Met Soc., F.Z.S., F.E.S., F.N.B.A., etc.

SUCH a soft round ball of furriness! It is hard to see so fascinating a little creature without wishing to have it as a pet, but only those who would sacrifice another's life to their own temporary gratification could have the heart to keep a dormouse in a cage. This wild little furry imp of Nature will not easily reconcile his freedom-loving soul to prison bars, no matter what pains one may take to amuse him and think of his comfort; not even will the revolving wheel, beloved of mice and squirrels, make up to him for the loss of freedom. In winter—his sleeping time—he may perhaps live for a few months, but sooner or later the day will come when the customary tapping at the bars of his cage will produce no response, and the dainty brown form is found inside limp and lifeless. Is it that in his wild, mossy home the dormouse finds some medicinal herb with which to tonic his little system, some magic elixir that we humans know not of? Or can it be simply a broken heart that causes him to wilt away and die? A few months ago I went to visit some old friends, and a charming child invited me to make the acquaintance of her pet dormouse. I had not the heart to tell her so, but as I stroked the little creature's silky coat I could not help wondering inwardly whether its number was already up. Some weeks later I learnt that my premonition had been only too well founded.

*Photo: Frances Pitt.*

Our friend the Dormouse has been allotted a place, in natural science, next to the squirrel, and, indeed, he is certainly more of a squirrel than a mouse.

Let us instead pay a visit to the dormouse in his natural surroundings. One may mention *en passant* that he deserves one half of his name better than the other, for *dormir*, to sleep, lends itself quite appropriately to a creature that spends several months out of the year in a state of profound somnolence. Scarcely so suitable, however, is the second half of the word. Picture a round, reddish-brown object, with a broad face and large shell-like ears, eyes like great liquid boot-buttons, and a thick feathery tail —and no wonder if he is offended at being classed with those vulgar little beasts that make hay of the housewife's store-cupboard or come nibbling at the wainscot when one is just dropping off to sleep! To many people a mouse is a mouse, to be exterminated or screamed at, as the case may be, and they would be astonished to hear that there may be four or five distinct species to be found in a country garden. Turn the leaves of any technical natural science book, however, and it will be seen that our friend the dormouse has been allotted a place next to the squirrel, with a comparatively long interval between him and the common house-mouse, with its cousins the various outdoor mice. He is certainly more of a squirrel than a mouse!

How shall we set about looking for him? Personally, I have never succeeded in finding a dormouse intentionally; the numbers that I have come across in my wood or garden having invariably been discovered by accident. Never shall I forget the first one that I found here one bright, crisp autumn afternoon. Picture in your mind's eye a long narrow lane, gradually sloping up towards the Downs, bordered on one side by a regiment of Scots firs and golden larches, with traveller's joy clambering to the topmost branches in mighty coils of rope, while beneath, the broad ditch and bank is a veritable riot of bramble and briar, pungent with the odour of moss and dead leaves, peppered with scarlet or jet-black berries and alive with the soft whispering of linnets and hedge-warblers.

On the other side lies the enclosure where my Japanese deer besport themselves, and there was at that time a certain spot where the hedge showed need of repair. I do not mind trippers looking through at the deer,

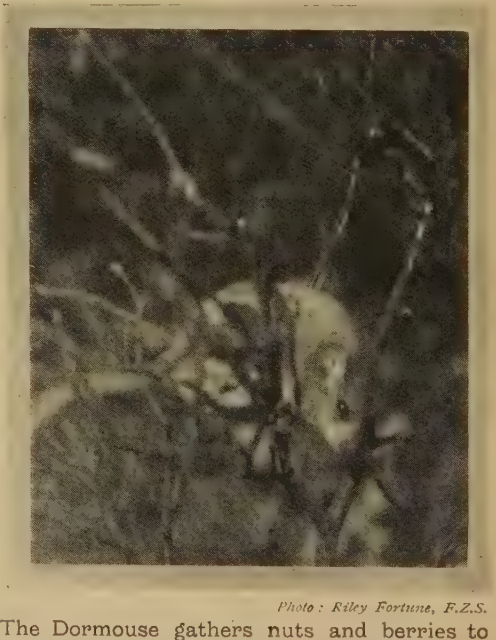


*Photo: Riley Fortune, F.Z.S.*

The Dormouse gathers nuts and berries to feed on in the spring, when he will be awake and lively—and abominably hungry into the bargain.

but I do object to small boys throwing stones at them. So I came down that afternoon with three or four sturdy young hawthorn bushes to plant in the widening gap. The ground was hard and stony, and honeycombed with roots, so I laboured on for some time with pick and shovel before there gradually forced itself upon my consciousness a curious rhythmical sound like that—on an infinitely smaller scale—of a broken-winded horse. I stood still and listened, but for some time it was impossible to tell where the peculiar noise came from. At one moment it appeared to be overhead, at the next I could have sworn that it was at my very feet. Groping about on my hands and knees, however, the asthmatic breathing sound became perceptibly nearer, and presently I succeeded in tracing it without doubt to a small bundle of leaves that seemed to have become wedged in between the roots of a dogwood sapling. A moment later that bundle of leaves was in my hands—just as it appears in the accompanying photograph—and I remained standing for an instant wondering whether something had gone wrong with my sense of hearing.

That apparently lifeless bundle of leaves

*Photo: H. Shepheard-Walwyn.*

A small bundle of leaves that seemed to have become wedged in between the roots of a dogwood sapling turned out to be the nest of a Dormouse.

was snoring with a degree of concentrated energy that would have given points to the occupants of a sleeping car on the Continental Express!

I knew at once what I had got hold of, and half an hour later was on my way to the studio with my camera in one hand, that noisy little bundle of leaves in the other,

*Photo: H. Shepheard-Walwyn.*

Cuddled up in a perfect ball of fawn-coloured velvet, the bushy tail curled upwards over his nose, the big bright eyes hermetically sealed—there was our Dormouse asleep!

and determination in my heart to make the young gentleman sit for his portrait. There was no hole of any kind in the nest, for the dormouse is far too cute to lay himself open to interference during his long winter sleep. He does not wish to take any chances, and an open front door would be distinctly tempting Providence—in fact, it took some time to force an opening in the compact inner wall of moss and grass-stems with which the little creature had built himself in. A set of delicate pale toes was the first thing I came upon—such fascinating little curled-up toes!

The next photograph shows the occupant of that bundle of leaves. Cuddled up in a perfect ball of fawn-coloured velvet (his colour runs to a rather lighter shade among these chalky hills), the bushy tail curled upwards over his nose, the big bright eyes hermetically sealed, fingers and toes tightly clenched . . . But the most curious part about him was the uncanny *cold* of his body!

Thus does he dream away the long winter night, snugly tucked away in his weather-proof nest, recking not of frost or snow, oblivious of blustering blizzard or slashing sleet . . . How convenient to be a dormouse!

He did not snore so loudly after I took him out. Perhaps because the air was fresher—it certainly must have been pain-

fully stuffy inside! But his breathing was just as violent. Indeed, his whole body was shaking and palpitating to such an extent that I saw at once the futility of attempting a time-exposure, and had to arrange my reflectors to get all the light available for a snap-shot. Except for this, however, a photographer would have described him as an "ideal sitter"—indeed he would probably have remained ideally sitting for the rest of the winter had I not replaced him in the nest as soon as it was over. Occasionally during the next few days, before taking him home again, I would pull him out to show to people, but he never attempted to wake, even when rolled to and fro upon the table. The only way to elicit any sign of life was to breathe heavily on his face, or hold him for a moment near the fire, when a sleepy paw would slowly uncurl to rub his nose with an air of infinite boredom.

*Photo: Frances Pitt.*

The living nest of the Dormouse perched upon the twigs serves his nocturnal habits very well. His front door, usually in the roof, is kept open during warm weather.

So much for the winter dormouse. It is no use trying to see him at close quarters during the summer months, for he invariably sleeps during the hours of daylight, and only comes out for food and recreation after dark. His front door, which is usually in the roof, is kept open during the warm weather, and out he pops as soon as the dusk begins to fall.

But is not the owl his deadly enemy? What chance for the slow lethargic dormouse if he only wanders abroad when that rapacious bird is on the warpath? Slow? Lethargic? Come down into the wood when there is a full moon and we may have a sporting chance of seeing him. There's the nest . . . Stand quite still and keep our eyes upon it. Listen! A faint rustling sound . . . a fleeting glimpse of two beady black eyes, like points of jet in the silvery moonlight . . . and before we know where we are the rustling sound is five or six yards off . . . Follow him? One might as well try to follow a will-o'-the-wisp! Springing from bough to bough, skidding down the trunks or slipping through the intricate maze of bramble and thorn—he would need to be pretty quick if he is not to become a tasty supper-dish for the trio of fluffy owlets in the tree overhead! Certainly one would never recognize in that elfin sprite, skimming with incredible rapidity from twig to twig, the lazy little fat lump that appears in the illustration on p. 281.

So it is in habits as well as in appearance that he resembles the squirrel rather than any other species of the mouse-tribe. There is yet another point in common, for both these fascinating rodents are in the habit of keeping a store cupboard. There is a popular delusion that they lay up a supply of food *for the winter*. "It is going to be a hard winter," one may hear people declare, "because there are so many nuts for the squirrels." As a matter of fact the dormouse does not even unlock his larder door if the winter is a hard one! Why should he wish to when he is fast asleep? The earlier part of the spring is the time for which he has made provision, when there are as yet no

*Photo : C. W. Colthrup, Z.P.C.*

**NEST OF THE DORMOUSE.**

Cunningly made of dried leaves and fern, the nest is almost imperceptible in the hedgerow.

fresh fruits on which to feed, and he sallies forth awake and lively, and abominably hungry into the bargain. Only upon one of those preternaturally balmy days, such as we are sometimes treated to in mid-winter by this wonderful climate of ours—the kind of day when golden butterflies come forth from their sleeping-quarters to dance awhile in the unaccustomed sunshine, while the big speckled thrush in the acacia lifts up his voice in an almost hysterical abandonment of exhilaration, when the cocks in the farm-yard are crowing their heads off and my white turkeys start dodging and curveting and chasing each other round the bushes like a demented school-treat—only then will the dormouse sometimes thaw himself sufficiently to come out and sneak round to the store-cupboard for a little nourishment.

But why come out? Has he not the sense to store his supplies in the nest ready to hand? On the contrary, he has *too much* sense to do any such thing. When it is said that he lays up a store of food, the picture conveyed no doubt to the average mind is that of the little brown form lying in a kind of miniature refreshment buffet, packed in with acorns and nuts like herrings in a barrel . . . No, indeed! The dormouse has enemies enough without gratuitously inviting interference at the hands of any passing creature whose sharp sense of smell could discover the proximity of eatables, and would probably mete out rough treatment to the luckless store-keeper in addition. What he actually does is to select a hiding-place at a short distance from the nest, and if, then, thieves do break in and steal—at all events his own slumbers will not be disturbed! This proclivity of his forms what is perhaps the only clue to the whereabouts of his winter hiding-place. Should one happen upon a little store of nuts secreted in some mossy nook or cranny amongst the interlacing roots of a tree, it would be fairly safe to assume that a dormouse has his nest not far away.

In this most defenceless of creatures we have an example of the wonderful instinct with which Nature has endowed the lower animals. The dormouse knows that the ripening of the nuts is a signal for him to be up and doing. No mere idle pastime is this winter sleep of his, but a serious business, and in autumn he sets about his preparations with a will, laying up store for himself *inside*, as well as out, to such good purpose that ere he folds his little hands to sleep at length, the usually lithe brown form has attained a degree of corpulence that puts one forcibly in mind of some Tenniel cartoon of an early-Victorian alderman.

*Photo: Frances Pitt.*

What young Dormice are like. It is not long before these wee furry imps will be darting about the hedgerows in the warm nights of summer.

*Photo: Alfred Taylor.*

Though they do look so wise, these are not five little gnomes but five young Barn Owls. They were hatched upon a beam in the great barn belonging to the farm where the children lived.

By OLIVE HOCKIN

## III.—What Happened to the Young Rats

ONCE more the children were out in the orchard.

Under a cherry-tree Topsy and Popsi were busy discussing the sad fate of the young robins.

"I wonder what Spring will do about it?" said Topsy. "She *did* promise that the rat should be punished."

"Oh dear! I do wish it had chosen something else for its babies' dinner!" sighed Popsi, torn between her interest in the young rats (whose nest she herself had discovered in the attic) and her grief for the little robins. The children had watched that robin's nest being built, taken count of each egg as it was laid, and visited them every day, until at last the eggs chipped, and the little naked, sprawling birdlings appeared. Then had come the tragic day when the nest was discovered to be empty, and the gardener reported having seen a rat leave the nest early that same morning.

"Let's come and find Spring," said Boodles, coming up at the moment. "I'm almost *sure* I saw her just now, under the big chestnut."

"Come on then!" said Topsy, jumping up. "We'll get her to tell us what she is going to do."

Away they all ran to the boundary hedge where the great chestnut held up its shining white candles amidst a tangle of bramble and oak and beam.

But what a lot goes on that children never see!

Up above them in the

cherry-tree somebody was sitting, listening to all their talk—a fluffy, brownish-greyish-whitish someone with a curved beak and big eyes.

"O - - ho!" said Tawny-owl softly, looking very round-eyed and wise. "Oo-hoo-oo!" said she. "Rats, is it? A nest of

Photo: Stanley Crook.

"O--ho!" said Tawny-owl softly.

young rats up in the attic! That will do me *fine*—I was just at my wits' end to know what to give my squawkers for supper! I'll be off and get them before Mother Barn-owl comes to know about it. It is really too bad the way she snaps things up, as if no one else in the world had any babies to feed!"

So saying, she dropped from her perch and skimmed silently over the tree-tops.

Meanwhile the children were searching for their friend, and there, amongst the sun and shadow of the chestnut, at last they found her—the laughing Fairy Spring. Boodles caught hold of one floating trail of sunshine, and they all clamoured round.

"No, no, children!" she protested, as they clambered in among the branches, piling her with questions. "I am really much too busy to tell you about it to-day. I have to work so hard painting the apple-blossom. You see," explained she, "it is so *many* different shades of red and pink! You don't know how careful I have to be if I want to make a really lovely spring!"

"Oh, but please——" cried Popsi, who could never take "No" for an answer. "Just say if you *have* remembered to see about it, 'cos we really-truly can't *afford* to lose any more little birds!"

"Why, yes," said Spring; "of course I have! And if you go and look in the attic to-morrow you will find there are no more little rats in that nest!"

"Oh! Please tell us what has happened to them," cried Topsy.

"Dear me! You must really try and find out something for yourselves," said Spring. "And it's your tea-time now, too! But I will give you a hint. To-morrow morning, go up the hill to the corner where the orchard meets the pine wood. Then if you search very carefully along the bank you may find out something."

Next morning, accordingly, first thing after breakfast, away ran the children to explore.

By this time they had learnt

*Photo: E. Step, F.L.S.*

There, amongst the sun and shadow of the Chestnut, they found her—the laughing Fairy Spring.

to go warily when they were looking for wild things, so, creeping along in single file, trying not to rustle a twig, they made their way along the bank.

Suddenly, just ahead of them, out flew our friend Tawny-owl!

"What was that?" cried Popsi, unable to keep silence any longer.

"Looked like a cat!" said Topsy.

"Pooh, silly! Cats can't fly!"

"Come on," said Boodles. "Let's see where it came from."

On they crept till they came to the spot from which the queer cat-like creature had flown.

Poking and peering amongst the hedge-growth on the bank, all at once Boodles nearly fell into a big rabbit-hole.

"Look out!" cried Topsy, "there's something inside!"

And looking in, what do you think they found?

Curled up together like one great ball of fluff, blinking and snoozing after an enormous meal, were three round, white, fluffy owlets! And in front of them lay the remnants of their feast—five long skinny tails of five young rats!

And that was all that remained of the rats that ate the robins!

*Photo: T. M. Blackman.*

This is Tawny-owl's nest in the entrance of the rabbit-hole. She does not trouble to build a nest, but lays her eggs on dead grass or decayed wood, or anything she may find. Very often she lays in a hollow tree, and sometimes she will use an old nest built by a rook or a magpie. She has to work very hard to bring her children enough to eat, and if it were not for her and other birds of prey, the country would soon be overrun with rats and mice.

*Photo: Henry Irving.*

The Hawthorn white is still the warm whiteness of abounding life, and its scent the very breath of spring.

# HAWTHORN TIME

By TICKNER EDWARDES

IN the deep of the scented pine-wood the turtle-dove has been crooning all the long May morning through. Measured and slow, the soft notes stemmed out upon the sunshine of the open lane; and though the quiet voice had but half the power of any in the great Maytide festival of song, it held the ear above all by its serenity and sober sweetness.

*Croo, Croo—oo, Croo.* Regular as a minute-gun, the gentle deliberate refrain stole out of the whispering darkness of the pines, and sank away into the ringing jubilance of the morning as a longshore ripple subsides into the sands. Each slow quatrain was overborne in a moment; but the singer, from her invisible perch deep in the sighing fragrant gloom behind me, kept on and on. And now it is high noon. One by one the minstrels of field and hedgerow have stilled their cheery pipes. Like a magician's spell, the noontide silence has fallen upon everything. Only the turtle-dove croons on, and that as sweetly, as insistently as ever. *Croo, Croo—oo, Croo.* Over and over and over again. It might be the drowsy golden midday sun dreaming, and singing in its dreams.

To almost all other wild birds, indeed, at this season of dawning summer, there comes this momentary halt in the long day's symphony. Yet the turtle-dove has not all the music-making to herself. With the hush of the torrid noon, the bees in the hawthorn-hedge seem but to lift a richer, louder chant than ever into the perfume-laden air. These many days past, though I have set out each time bent on a long morning's ramble, I have never been able to get farther than the hawthorn lane. The hedges here are greater grown and more ancient than any on this countryside. Unkempt, uncut,

for generations, they tower aloft loaded to their summits with white hawthorn bloom —on the one hand the glowing barricade of blossom silhouetted upon the darkness of the pine-wood ; on the other the laden bushes making a lofty screen against the sun, within which the light interlaces its glittering tangents like gold threads woven into a bridal gown.

To pass this way in hawthorn time is to put an end to any farther peregrinations bridal-way than ever, but it will wear the cold whiteness of a thing out of which life has passed. It will be small comfort then to think of autumn and the old lane shining from end to end with scarlet fruit, food enough for all the birds whose song makes the gladness of each year's round. Doubtless it is true, in the ultimate, that what one sows is not quickened except it die. But that one is a fool indeed who wastes a single moment of joy on mortality, for all its

*Photo: J. T. Newman.*

When the noontide silence has fallen upon everything, only the Turtle-dove croons on, and that as sweetly and insistently as ever.

for the day. While the may lasts in its full perfection of beauty, there is nothing else that really matters. It will soon be gone. To-day the mountains of white blossom overhead still show that pristine virgin warmth that holds while the anthers of each flower retain their deep rosy hue ; and there are yet a thousand buds to blow. To-day the hawthorn white is still the warm whiteness of abounding life, and its scent the very breath of spring. But these winged plunderers from the hives will soon have wrought havoc with its loveliness. In a day or two the rosy anthers will have yielded up their glow of youth. To a casual eye, the lane will be a whiter, more resplendent present evident and inevitable use. The instinct to take supreme beauty of flower and song as a be-all in itself, is the true instinct of one born to the eternal quickening.

It is the quiet noontide hour. The thrush has laid down her silver pipe for the nonce, and the blackbird has given over his mellow tranquil fluting. The swifts no longer weave their coal-black pattern against the sky. In her cool dim nook within the pine-wood, the turtle-dove croons on, yet with a softer, drowsier cadence than ever. And now the faint hot wind stirs in the tree-tops, bringing back a long-forgotten sound—the lilt and surge and crisping ripple-song of summer seas.

THE WHISPERING DARKNESS OF THE PINES.

Now every wandering zephyr can play upon their supple sappy growth as upon lute-strings of tender resonance.

While the May lasts, there is nothing else that really matters.

THE HAWTHORN IN IT

It will soon be gone, but to-day
while the anthers of each flowe

*Photo: Henry Irving.*

**LL PERFECTION OF BEAUTY.**

mountains of white blossom on the slopes still show that pristine virgin warmth that holds ain their deep rosy hue.

*Photo: G. Clarke Nuttall, B.Sc.*

The hedges towering aloft loaded to their summits with white Hawthorn bloom, made a lofty screen against the sun, within which the light interlaces its glittering tangents like gold threads woven into a bridal gown.

To the sojourner far inland used to sea-sounds of old, this surging, swinging note of wind in summer pines comes with almost a startling sense of recognition. Winter winds draw an altogether different voice from the matted pine-boughs. Then, though the trees are as densely green, their myriad needle-leaves are old and dry, and the fiercest blast can lash from them only a wheezy brittle music. But now every wandering zephyr can play upon their supple sappy growth as upon lute-strings of tender resonance. It is not storm with which the wind in summer pines challenges the memory, but the harmless jollity of wavelets cresting into lazy foam over the slumbering blue of mid-ocean, a sound mirthful and free, of an easy indolence yet full of a sense of giant strength laid by: for one, knowing the deep sea of old, to loiter here in the lee of pine-woods on a fine May morning, hearkening to the tolling song of the dove and the breath of the warm west wind in the green woodland roof, is to live again maybe many vanished years of youth soaked through and through with ocean brine and old "wind-jammer" memories.

Idling along between the shining palisades of hawthorn bloom, and musing thus on ancient ways and days, time passes for one all unmarked. An hour has gone swiftly by, and now the Maytide songs are picking up again one after another. The nightingale—true daylight singer, for all his conventional ascription in poesy—is almost the first to take up the broken theme. He sits in the hedgerow deep within a bay of blossom on the sunny side, so that I cannot see him; but there is no doubt of the peerless song. It begins with half a dozen low, long-drawn-out notes, perhaps the saddest and sweetest sound that ever rang from throat of bird. Now there comes a telling pause, as though the singer

THE RHODODENDRON'S REGAL ROBE OF PURPLE.

*From a Painting by Arthur J. Black, R.O.I.*

were at a loss to find tones grievous enough to vent his melancholy. And now he seems to give up the hopeless attempt, lets himself go in one passionate outpouring of melody—a sudden tumultuous freshet of silver notes poured out upon the sunshine moment after moment as if the reckless cataract of pure sound would never cease. Then the low, slow, sorrowful refrain once more ; again the eloquent pause : and again the breaking flood-gates of music.

One listens to the nightingale year after year, and familiarity only breeds a surer faith in the matchless quality of his voice. But, if the truth must be told, as a musician, he has neither great competence nor any really subtle sense of artistry. Listening to him now amidst the fast re-awakening concerto of Maytide voices — blackbird and thrush, missel and chaffinch and robin breaking out again on every hand—one is forced to concede that a minute of the King Merle's masterly strain is worth long hours of the nightingale's untimed, untutored medley. Sweet it is, there is no gainsaying ; and pure and free as any sound between earth and sky. But on this abounding, overbrimming May morning, the song fits in with human need and hope little more than the bag of pearls fitted in with the need of the starving traveller on the desert. Mere quality of tone is not enough ; the wanted thing is meaning, meetness. The nightingale's song, to me, is as though some child had found by the wayside an instrument of priceless worth, and were but ignorantly, unthinkingly, strumming on it to beguile a moment's tedium.

Down by the river, at this glowing time of fulfilment, one comes upon much the same thing in somewhat different guise. Here it is, the little sedge-warbler fretting out his soul deep in the waving jungle of reeds. The May sun lords it in a cloudless sky. The singing water flows through a world of beauty—living sound and colour,

*Photo : G. Clarke Nuttall, B.Sc.*

The plunderers from the hives will soon have wrought havoc with the loveliness of the May. In a day or two the rosy anthers will have yielded up their glow of youth.

form and fragrance. There is joy in the very air ; nothing breathes on earth but is full of joy, from the larks carolling high up against the blue sky to the tiniest atom of insect life creeping in the amber heart of any one of the myriad dandelions aglow in the wayside dust. Only this restless, flitting, unsatisfied creature, invisible in the thicket of green reeds, is at odds with the morning. His fretful, chiding, care-ridden note goes ceaselessly on, girding at everything ; its very sweetness of tone bringing its incongruity only into sharper relief.

*Photo : Henry Irving.*

Clematis is steadily pushing up, and soon will overflow the hedge in a cascade of green.

To lay to the score of wild natural life these anthropomorphic traits with any serious insistence, is, indeed, but to tread on the skirts of folly. Yet, as all human earth worshippers know, there is a sort of truest comfort in this. If one can find one's own fancies and foibles, and even little clevernesses, echoed in the life and ways of bird or plant, it all goes for testimony towards the one mysterious yet incontrovertible fact of the unison in all creation. These ancient hedgerows loaded to the skies with blossom and green growth, give out a perpetual echo and re-echo of all that stirs in my own heart and head as I wander down the shining alley of the old lane. Gain of place, and assured leisure for fruition, spiritual or material, in human life, depend in the main on whether adroitness wait rightly and timely on opportunity. And in the methods and little ingenuities displayed by the hedgerow climbing plants alone, one sees on every hand one's own innate contrivances working out in leaf and stem, obedient to the common principle. Individualism, the master-seal and token of all created life as we know it, is as paramount here as in humanity's thronging quickset hedge.

Honeysuckle and clematis, red and black bryonies, nightshade and hops, all are steadily pushing their green bines upward through the shimmering labyrinth of hawthorn bloom. In a month, when the white may-radiance will be but a memory, all will have over-reached the hedge-top and be stretching out long arms to the empty sunshine above. Each depends on the close-knit, sturdy thorn-branches for ultimate support ; yet, in the task of winning a way through the wilderness of verdant prickly growth, each follows its own intrinsic leaning.

It is the nature of the hop plant to twine round everything in its path. The hop has no main stem, but from the root divides itself into numberless slender snake-like tentacles that, ever gliding spirally forward, contrive a way infallibly through the densest impasse of leafage. Arrived at the uppermost limit of the bush, the hop, of all other climbing plants alone, has the means still to continue an upward course. If there be an overhanging tree-bough within a yard or two, the hop is bound to gain it, and thence clamber indefinitely skyward. It performs this surprising feat by erectly twining perhaps a dozen of its lithe stems together. One of the tender flexible wands could not by itself

*Photo: Henry Irving.*

In another month the Bryony will have over-reached the hedge-top and be stretching out long arms to the sunshine.

*Photo: E. Step, F.L.S.*

The snake-like tentacles of the hop ever gliding spirally forward, contrive a way through the densest impasse of leafage.

bridge more than a few inches of space; but a number, tightly locked together in a solid spiral green column, will mount straight up a couple of yards into mid-air.

Black bryony and clematis depend for their aspiring powers not on twining but on clinging. Whenever one of their tough leaf-stalks touches anything in its path, it immediately takes a strong double-turn about the obstruction, and uses this fulcrum to impel its stem farther afield. Thus these plants, indefinitely repeating the manœuvre in all directions, will bind a whole bush into one solid mass of alien green.

The honeysuckle, relying on the amazing strength of its stem, just pushes ahead regardless of all obstacles until it breaks through the hedge-top at last like a thrust spear.

But the red bryony affords the most telling instance of this hedgerow strategy. In itself, the plant has no gripping or resisting power of any kind, but it is endowed with inveterate persistence. It succeeds in smothering the whole bush with its delicate vine-shaped foliage, and will hold its own against the mightiest winds when far more sturdy growths are beaten down.

To accomplish this, the plant throws out an infinity of tendrils fine as a hair, branched and rebranched, and each fashioned into a delicate spiral spring throughout its length. With the forked tendril-tips it lays instant hold on every twig in its path, the springs yielding yet never breaking under any stress, and by sheer numbers ever assuring to the plant safest anchorage and progress.

And laying hold on life as these climbing plants of the hedgerow lay hold of thorn or brier—whether I be born twiner, clinger, bold headlong thruster, or master of deft ju-jitsu art—I am unspeakably, albeit perhaps a little unwarrantably, comforted, to see my own visage of mind and heart reflected in every sight and sound of nature's radiant gala-way.

*Photo: A. M. C. Nicholl.*

The little Sedge-warbler fretting out his soul in the deep waving jungle of reeds.

# Wild Flowers and Their Ways

## 6.—THE TOILET OF THE IRIS

By A. HAROLD BASTIN

With photographs by the Author

HAS the reader ever witnessed the unfolding of a flower—not on the screen of a picture palace, but in the open air amid the glories of an early summer morning? Of course the "movies" provide the more sensational spectacle, for by their aid we see crowded together, within the course of a few seconds, the whole series of changes which connect the first swelling of the bud with the perfectly expanded bloom. Yet the "real-thing" is indubitably more impressive, more dignified, above all more eloquent of Nature's sublime sufficiency and unhurrying purpose. We realize that this is no chance happening, no puppet-show planned to while away an idle moment, but an intensely serious business which has been long in preparation; that each movement has been rehearsed (how many billions of times none may guess!) until a machine-like precision has been attained; yet, withal, that what we see cannot be cramped within the category of mechanics: for is it not life itself in action?

The bud of the Iris photographed at 7 a.m. A bud at this stage of development will become a perfect bloom ere the day is far advanced.

Iris—type of the classical *fleur-de-lis*—ranks among the stateliest of blossoms. Yet she is condescending, or, as the florists phrase it, "of easy culture"; so that we may find her thriving, in some at least of her many forms, even in the parks and gardens of our great cities. Thus, all those who desire to witness her toilet may readily do so, if they will but rise early enough and exercise patience. No other precautions need be observed, for fear and bashfulness, coquetry and display, are alike unknown among the beauties of the vegetable kingdom. Alone in the morning sunshine, or watched by a thousand pairs of eyes, Iris will not depart one jot from the order of proceedings that has been customary with her ancestry from time immemorial.

Within the pointed green bud, all preliminaries have been brought to a successful conclusion. The flower is complete in every detail, but folded together and packed with inimitable skill into the smallest possible compass. On the day preceding that which is destined to witness the flower's début, the green

The same bud as seen at 10 a.m. The transformation from this stage to the next is effected with surprising rapidity.

At 10.10 a.m. "My Lady" Iris is seen in the act of shaking out her frills and flounces.

outer wrapping is pushed aside, and the naked bud appears. In the period which intervenes between this event and—let us say—seven o'clock of the following morning, a definite enlargement of the bud is effected, consequent upon a progressive loosening of the petals and a steady inflow of sap; so that the experienced gardener, entering his domain before breakfast on a fine sunny morning, is able to predict with certainty that *this* bud will be transformed into a perfect bloom before the day is far advanced.

The photographs which are reproduced on these pages show several of the more interesting stages in the process of development. Special attention is directed to the fourth and fifth pictures of the series. To the casual observer the flower as seen in the first of these would probably appear complete; its symmetry is perfect. Yet to the critical eye of Nature (if we may, for a moment, figure her as a watchful goddess intent upon the decorous ordering of the universe) something is still needed. You know how a guardsman in full marching kit, who has been "standing easy," will suddenly, by means of one deft shake, bring his pack and accoutrements into place before he springs to "attention"? This is exactly what happens in the case of the flower; only the "shake," instead of being instantaneous, is spread out over fifteen minutes or so, and is *too slow* for the eye to follow! Nevertheless, the camera shows clearly that it occurs. One is reminded of Mr. H. G. Wells's story of "The Time Machine." Here, in real life, the machine seems to be running slowly—so slowly that, if we judge solely by what we see, we must conclude that there is no movement at all taking place. But by the aid of the cinematograph we can "speed up" the action until the final

Five minutes later she has attained her characteristic symmetry

touches in the toilet of the iris seem to occupy no more time than the guardsman's shake.

Now, what is the meaning of this thing of beauty—the perfected blossom—which is the climax of the plant's annual effort? Truly its loveliness is not without significance; but the more closely we peer into Nature's ways, the more we learn to expect some "usefulness" from every perfect thing. There was a time when a flower was thought to be "just a flower and nothing more"—a pretty trifle specially contrived to divert mankind. That flowers have, indeed, played an important part in educating man's æsthetic faculties cannot be doubted; but we know now that flowers preceded man, possibly by billions of years, in the evolutionary process, and that their primary use was to benefit the plants which produced them by enabling them the better to set good seed. This flowers do by attracting insects, which get powdered by the fructifying dust, or pollen, and transfer it from one bloom to another—thus effecting "cross-pollination.'

Apart from the orchids (those aristocrats of the plant world), the irises rank as the most highly specialized flowers of that class of plants known as "monocotyledons"—i.e. plants (like the wheat) which start life with *one* seed-leaf, or "cotyledon," as distinct from those (such as the bean) which begin with *two*. If we examine critically an iris bloom, we shall find that its "perianth"—the group of specialized leaves which are commonly called "petals"—consists of six parts, viz. three erect inner "standards" and three recurved outer "falls. The former are usually self-coloured; but the latter are frequently netted and veined with a dark tint on a paler ground. The network and lines converge towards a sort of throat leading to the tubular region at the base of the perianth, and are believed to act as a kind of time-saving device which enables the visiting insect quickly to find its way to the nectar.

The iris is especially frequented by humble-bees. The bee alights upon one of the "falls," and at once—by means of its long "tongue"—begins to probe the depth of the flower where the nectar is stored. To do this it has to push its head and the fore part of its body into the "throat" just referred to; and in this way its hairy back comes into contact with the sticky stigmatic surface, which is on a little flap. Supposing that the bee has flown from another iris bloom, the stigma will be "cross-pollinated." Immediately after touching the stigma, the bee brushes against the pollen-shedding anther of a stamen. Finally, when the insect backs out of the "throat" (carrying with it a fresh supply of pollen), it pushes over the stigmatic flap in such a way that the receptive area of the stigma is covered, and the risk of "self-pollination" is avoided. But if the bee subsequently visits another iris bloom, "cross-pollination" results.

Fifteen minutes later (10.30 a.m.) she has added the finishing touches to her toilet and, perfectly arrayed, awaits the addresses of the humble-bee.

The ingenious mechanism which has just been described is thrice repeated in each iris bloom—each third thus resembling an irregular flower. It is, perhaps, a little complicated. But the novice will readily grasp the method of its working—(1) by pulling an iris bloom to pieces and studying the arrangement of its parts, and (2) by watching a humble-bee in the act of entering and leaving the "throat."

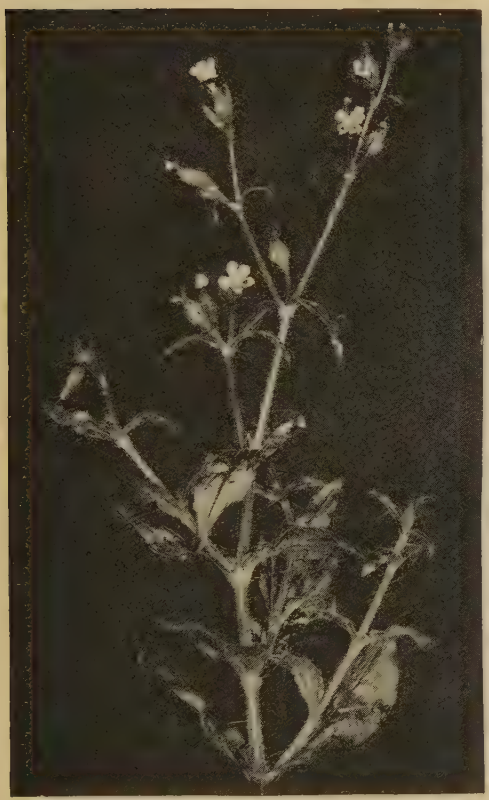
If the bee visits in rapid succession all three sections of an iris bloom, there is clearly a risk of "self-pollination." But this risk is probably more apparent than real; for experiment tends to show that pollen brought from a distance is "prepotent" over that which the flower itself has produced—which means that a few stray grains of foreign pollen may succeed in fertilizing the ovules while the home-grown grains are still "thinking about it," so to say

Iris—type of the classical *fleur-de-lis*—ranks among the stateliest of blossoms.

# 7.—CINDERELLAS AMONG PLANTS: FLOWERS THAT BLOOM BY NIGHT

By G. CLARKE NUTTALL, B.Sc.

With photographs by the Author



A Night-flowering Campion : attractive with white starry flowers *at Night*—

THE fairy tale of Cinderella finds its counterpart among the plants. All the main features of the story are there—the drabness by day, a fairy touch, brilliance by night, a persistent wooer, and a return to drabness with the morning.

In the hedgerows and fields there occasionally grows an uninteresting looking plant about a foot and a half to two feet high. Its stems are coarse and sticky, its leaves dull and hairy, while in the sunlight its flowers are represented by miserable and withered looking buds of a dirty green colour. If one's attention were called to it—one would hardly notice it otherwise—one would probably remark with an old-time botanist, "What a gloomy plant!" just as we can imagine a visitor to the "Ugly Sisters" saying of Ella of the cinders, "What a dull little girl!" Plant and girl were certainly unattractive until the fairy touch came at evening time.

The fairy godmother, in the case of the plant, is the gathering dusk. As the sun sets

—Dull and uninteresting *by Day*.

and night begins to take all nature into its embrace of oblivion, the harshness of the plant's lines are softened and the withered looking flower buds begin to unfold their five shabby grey-green petals. And behold, their inner side proves to be a pinkish-white, and soon a number of ten-rayed stars—for each petal is partly cleft in two—have taken the place of the shabby buds and gleam out into the night. A faint scent like that of hyacinths begins to exhale, and down in the depths of the flower nectar appears. The plant, like Cinderella, has donned a festive garb for its " night out."

The Evening Primrose *by Day*. Notice the long interlocking points to the sepals. A bud will change into a full-blown flower in the space of a couple of minutes.

It is not long before the Fairy Prince, in the shape of an owlet moth, lured by the fragrance and the sweetness, comes softly flying towards the gleaming stars, and gently settling upon one after the other, sips the nectar from their hearts. So the early hours of the night pass, the flowers alluring, the moths visiting and incidentally laying their eggs within them, until the first gleam of dawn ends the idyll, as the stroke of midnight ended Cinderella's glory. The scent fades away, the white petals wrinkle and droop, closing the mouth of the flower and hiding their whiteness; by three in the morning the plant's " night out " is ended, and the morning sunshine shows only the uninteresting ugly plant once more.

Like Cinderella, too, the plant has three nights in which to charm, but with a different programme for each night. The first night, when the petals smooth out their wrinkles and range themselves star-wise, five little stamens which stand within, alternating with them, push out in the centre, their yellow heads full of pollen dust. These heads open and the pollen shakes out, so that when the moths come and settle on the flower their soft bodies become coated with it and they carry some, at least, away with them. At dawn these stamens shrivel and fade with the petals—their share in the life of the flower is done.

The second night, when the white stars appear, a second ring of five stamens pushes out—for every flower holds ten of them—and this time they are opposite the petals. Again the same routine is followed, they scatter their pollen on the insect visitors, and early morn sees them also shrivelled.

But on the third night the programme is varied. When the dusk arouses the flowers once more for the nightly vigil, in the place of the ring of stamens there are several green columns rising straight up from the seed-case at the base of the flower; and they stand there waiting. So far the flower has given everything and received nothing, but on this last night of its life it is its turn to receive. It is just as attractive as ever, the nectar and the scent are just as alluring, so the owlet moths still come with their bodies covered with pollen from flowers already visited, and as they settle and sip in the centre of the flower, some of the pollen grains they have brought rub off on to the ends of the green columns and are left there when the visitor flies away. And once more dawn comes and the petals droop and wither and the flowers close. This time the closing is final—the hours of brilliance will never return; but within the closed petals the pollen grains are lengthening and creeping

to the immature seeds in the seed-case below, so that these will be fertilized and, in due course, develop into white campions of the next generation. For this Cinderella of the plants is a night-flowering campion, of the family of the pinks and the sandworts, ragged robin, and the corn-cockle. Sometimes it is known as " catchfly," because the little creeping insects—chiefly ants—that would steal the nectar, without paying the price by carrying pollen, are caught on their marauding expeditions by the stickiness of its stems, and thus meet their doom.

As for the eggs that the moths have laid in the flowers, these hatch into grubs, who first of all eat some of the tender seeds and then bite their way out through the green seed-case wall. In this way they do some damage, but in bringing about cross-fertilization the moth conferred a greater benefit, so that, on the whole transaction, the plant stands to gain more than it loses.

Several other kinds of campion, such as the Nottingham catchfly and the white lychnis, also open their flowers for the first time at night, and appeal to the moths. Some of them carry their flowers over through the next day, but their zenith is always at night, and they all have three days as the allotted span of life.

It is an interesting point that if the weather is bad and there is no chance of insect visitors, some of these flowers may not open, but, making the best of a bad job, fertilize their ovules with pollen from their own stamens.

The evening primrose is another Cinderella-like flower and is remarkable for the rapidity with which it bursts into flower. It always happens in the late afternoon or evening. Its long buds are tightly enclosed at first by four sepals with long points, which points interlock one with another. As the time of bursting draws near the swelling of the bud exerts more and more pressure on the locked tips until finally it becomes too great for them to resist and they give way with a jerk; the flower unfolds before our very eyes, and the whole process takes only a minute or two.

The next stage also is interesting. The young bud stands erect, but the flower opens laterally. Its pale yellow hue makes it conspicuous in the dusk; it is fragrant, too, and contains nectar, and any moth visitor, probably a sphinx, hovers in front and inserts its long proboscis down the centre of the flower. Observe that when the flower first opens the eight stamens fill the centre, hence the moth necessarily brushes its head upon them, and on flying away carries off some of their sticky pollen. In the course of half an hour or so, the green column from the seed-case, which has hitherto lain quiescent, lengthens and raises itself, and opens at the end into a large cross. This " stigmatic " cross stands in front of the stamens, so that moths now visiting must press their heads upon it while they sip the nectar, and if there is any pollen on the stamens some of it will, no doubt, adhere to the stigma and so fertilize the flower.

The Evening Primrose *by Night*. In the right-hand flower the stamens are the prominent feature; in the left-hand flower, the central column has grown beyond the stamens and opened to form a large cross. The latter flower is probably only one hour older than the former.

Next morning the flowers have a distinctly dissipated look, and before long the upper part falls off and only the long seed capsule remains.

The sandhills at Ravenglass, Cumberland, are a favourite breeding ground of the Terns and other sea-birds.

# 13.—THE TERNS OR SEA-SWALLOWS

By RICHARD KEARTON, F.Z.S., etc.

With photographs by the Author and Grace Kearton

THE terns generally have been popularly named sea-swallows because of the fact that their long sword-like wings and forked tails render them somewhat similar in appearance to the common barn swallow.

They breed on small maritime islands, on shingly beaches, rocky coasts, sandy shores and on islands in freshwater lakes. Generally considered, they are gregarious, although I have found isolated pairs of common and Arctic terns breeding far away from any other members of their species.

The common and Arctic species are so much alike in size, appearance and habits that it is hazardous to mention any single characteristic by which they can be distinguished with absolute certainty whilst on the wing. It may be mentioned, however, that the former bird has its pinky red bill tipped with black, whereas the latter has not. The common tern stands rather higher than its relative the Arctic tern, and,

The Common Tern arrives a little earlier on our shores in spring than the Arctic species.

Common Terns are rather spiteful birds during the breeding season. They have been known to kill young, and even adult, partridges that had accidentally strayed on to their breeding ground.

The Sandwich Tern, like most of the family, will sometimes build a nest of this character—

human intruder upon its privacy. I have been vigorously pecked by an individual of a large colony whilst in the act of photographing her eggs, and was once bitterly assailed by one member of a solitary pair of birds breeding far from any others of their kind in the Shetlands.

The common tern arrives a little earlier on British shores in the spring than its aforementioned relative, and is more numerous as a breeding species round the English coast. Although this bird frequently dispenses altogether with nesting materials, it is in my experience more prone to use them than its previously mentioned relative.

in the hand, there are other characteristics of plumage that help the ornithologist to distinguish the species. The eggs of the common tern are slightly larger than those of the Arctic, but they vary in coloration in each species to such an extent that it is wellnigh impossible for even the experienced oologist to identify them with certainty.

The Arctic tern, which is one of the greatest feathered travellers in the world, and is said to wander almost from Pole to Pole, arrives on British shores at the end of April and beginning of May. Although it outnumbers the common species as a breeder in Scotland, it does not do so in England, where the Arctic tern may be found breeding freely with members of that species on the Farne Islands and other haunts. As a rule it does not trouble to build even a scanty form of nest, but simply drops its two or three eggs into a slight scrape or on bare rock. I have often seen them lying cold and deserted in some crevice half filled with rain-water.

The Arctic tern is a bold bird, and will not hesitate to attack even a

Sweethearting amongst all the sea-swallows is carried on by food offerings on the part of the gallant to the fair, and I have on many occasions watched the male common tern feed the female as she sat covering her eggs; but whilst studying a pair in the act of hatching out their young ones on Texel Island, I was struck by a rather singular fact. The male bird refused to give a freshwater shrimp he had brought to his mate, but, instead, delivered it to the elder of

—but at other times will merely deposit its eggs on the bare sand.

**SANDWICH TERN APPROACHING ITS EGGS.**
This is the largest of the Sea-swallows that breed in the British Isles.

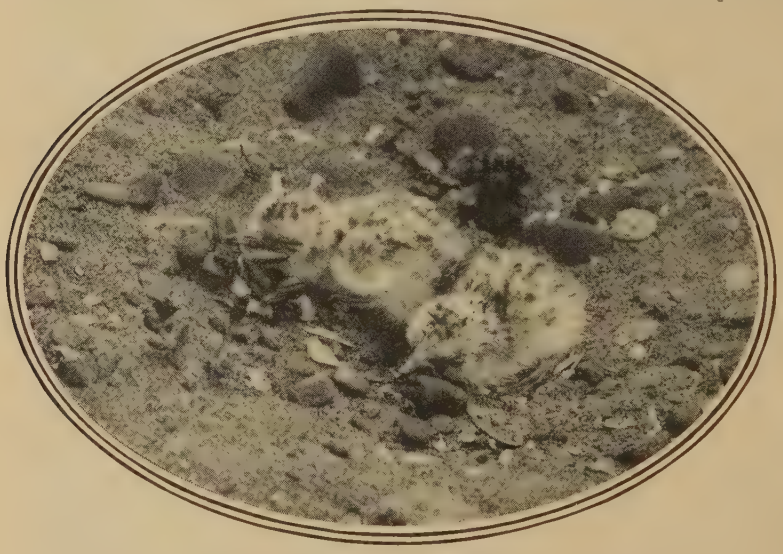
two chicks; then he sat down in the nest and practically sent the female away on a foraging expedition.

The common tern is rather a spiteful bird during the breeding season. I have watched a dozen or more attack a young black-headed gull that had accidentally strayed from its own domain on the sand-hills down to a flat piece of ground occupied by terns, and roll the unfortunate chick over and over until the battered and bewildered creature was fain to pick itself up during a respite and beat a very hasty retreat to its own quarters. Infuriated sea-swallows have been known to kill young and even adult partridges that had accidentally strayed on to their ground. Two or three years ago I was compelled to end the miseries of a young rabbit I found in a great state of distress and suffering in a tern colony. Although I did not see any bird actually attack it, the unfortunate animal's condition convinced me that it had been savagely assaulted.

The voices of birds are very difficult to render by the characters of the alphabet, but the call of the Arctic tern has been rendered as *Krr-ee*, and that of the common tern as *Pirre* with an additional sharp *Kit*, *Kit*.

The sandwich tern is the largest sea-swallow found breeding in the British Isles. It may be studied successfully both at the Farne Islands and Ravenglass, where a good light will reveal the interesting fact that its under parts, as in the case of the rarer roseate tern, are tinged with a rosy hue. It is a great wanderer; European-bred specimens fly as far south as Natal in the winter.

It will be noticed that the black hood is beginning to disappear from the forehead of the individual shown on p. 309 and in our photogravure. Although the photograph was taken in June, some ornithologists consider that the bird was already reverting to its winter plumage.



The Lesser Tern's nest is at the most a hollow scraped in the sand or shingle, and here the young chicks are hatched.

In spite of being gifted with good eyesight, I must confess that I have not always been able to distinguish clearly the evanescent salmon pink tinge on the under parts of the roseate tern when I have had the bird pointed out to me by watchers on the Farne Islands. Some naturalists say that members of this species are more easily distinguished by their blacker bills and longer tails. The attenuated form of the bird is a helpful guide, and in consequence of this peculiarity the roseate has been said to occupy the same position amongst terns that a greyhound does amongst dogs.

The plumage hunter and the egg collector were at one time thought to have banished this species from British shores, but luckily such is not the fact.

The lesser tern, or little tern as it is sometimes called, may be easily distinguished from all other British sea-swallows by its smaller size, the white patch at the base of its upper mandible, the marked difference in its call notes, and the quicker beat of its wings.

It is found more or less all round the coast in the breeding season, where condi-

The Lesser or Little Tern may be distinguished by the white patch at the base of its upper mandible.

The Arctic Tern is a bold bird, and will not hesitate to attack even a human intruder upon its privacy.

tions are favourable, but nowhere in great numbers. I think the largest colony I ever met with consisted of about twenty pairs, and these were scattered over a considerable area of ground. The lesser tern will deposit its two or three light stone-coloured eggs on shingle or in a slight hollow scraped in the sand. Occasionally the eggs get washed away by an abnormally high tide, and during windy weather they are sometimes buried by drifting sand during the mother bird's absence. I have on several occasions had little terns threaten to attack me whilst examining their eggs or young, but have never actually been struck.

Although the black tern used to breed with us in great numbers in Pennant's time, it no longer does so, and I must admit to a considerable difficulty in understanding why this should be. It is by no means a shy bird, and is capable of adapting itself to widely different breeding conditions. I have stood and watched it catching flies in the grass and harvesting aquatic food from dykes within a few yards of me, and have been boldly attacked by it when standing near a nest. It swoops down upon the head of the intruder, strikes with its bill, and with an angry cry flies round to make ready for another assault.

The older writers attribute its disappearance from Britain as a breeding species to drainage and cultivation under the evident impression that the bird must have a situation "which rises and falls with the water." As a matter of fact, the bird shown in our illustration was nesting on dry, firm meadow-land. On the other hand, colonies are to be met with breeding on floating masses of vegetation where the materials of their nests—decaying pieces of all kinds of aquatic plants—are absolutely saturated. Conditions of this character are to be found round the Narder Mere, near Amsterdam, where the black tern breeds in considerable numbers; but I must confess that many of the places where it may be met with nesting on the Continent do not appear one whit more suitable than certain parts of Norfolk.

It calls to see us every spring and autumn during its migratory flights to and from its breeding grounds, but why it does not even attempt to stay and breed in Britain again as of old is to me a mystery.

The Black Tern at one time bred regularly in the British Isles; but now it gives us but casual calls when passing to and from its breeding grounds.

SANDWICH TERN ON NEST

Although the picture was taken in the month of June it will be noticed that the black hood of the summer plumage is beginning to disappear

*Photograph by R. Kearton, F.Z.S.*

LESSER TERN ALIGHTING AT ITS NEST AMONG SHINGLE

LESSER TERN ON ITS NEST

*Photographs by T. M. Blackman*

ARCTIC TERN ALIGHTING AT ITS NEST

*Photograph by M. Best*

A GROUP OF NESTING SANDWICH TERNS

These birds fly as far south as Natal in their migratory journey

*Photo: B. Hanley.*

On a fine day Gulls may be seen sailing high in the air, without apparent effort, as though it were not necessary for them ever to descend

# 14.—PLEASURE IN OUTDOOR NATURE; STUDY OF BIRDS.—Part I

By THE RIGHT HON. THE VISCOUNT GREY OF FALLODON, K.G.

THE imparting of pleasure, it seems to me, is a very important part of education. There is a great deal of discontent in the world; some is due to poverty, to ill-health, to want of leisure, to over-work, to unhappy outward circumstances; moralists would say that much of it is due to the fact that people have not sufficient moral basis, to which an American girl is said to have retorted, "No doubt people who are good are happy, but they do not have a good time." That sort of discontent with which the moralist or economist has to deal is outside my subject. The proposition I would put to you is this, that people who have a reasonable amount of leisure should have a habit of spending that leisure and a capacity for spending that leisure in a way that brings interest and pleasure, and that this is a great factor in making life contented. That is the proposition. For this purpose, if you can impart the power of taking real pleasure in the best poetry and the best literature, no doubt you will have given the most easily accessible and most permanent and lasting form of making leisure satisfactory; because books, even the best, are easily accessible, and all that is necessary for the enjoyment of them is that you should, in fine weather, find some quiet spot out of doors, or that you should

A lecture delivered to the Nature Study Union. Reprinted by courtesy of the Union.—*Hon. Sec.:* Henry E. Turner, 1, Grosvenor Park, Camberwell, S.E.5.

have access to a room in which there is no telephone.

Books I would put first. By books I mean the power of taking pleasure in the best literature. But next to books I would put the capacity for finding pleasure in outdoor nature. There are two great advantages in it; two great qualities that belong to it. One is that it means a capacity for taking pleasure in common things. The beauty of the world and the interesting things in wild nature are there for everybody to enjoy, and the fact that one person enjoys them does not diminish the power of others to enjoy them, provided only that everybody, who takes pleasure in outdoor nature, will observe the one simple rule, which is far too often broken, that you should take your pleasure in outdoor nature without destroying or disturbing. As long as you do that your pleasure is not diminishing anyone else's pleasure. For instance, supposing you are in one of the London parks, and there happens to be, as happily there often is, a thrush or blackbird singing, and you stop to enjoy the song, the fact that someone else stops to enjoy it does not diminish your pleasure, but increases it; but if someone throws a stone at the bird he destroys your pleasure.

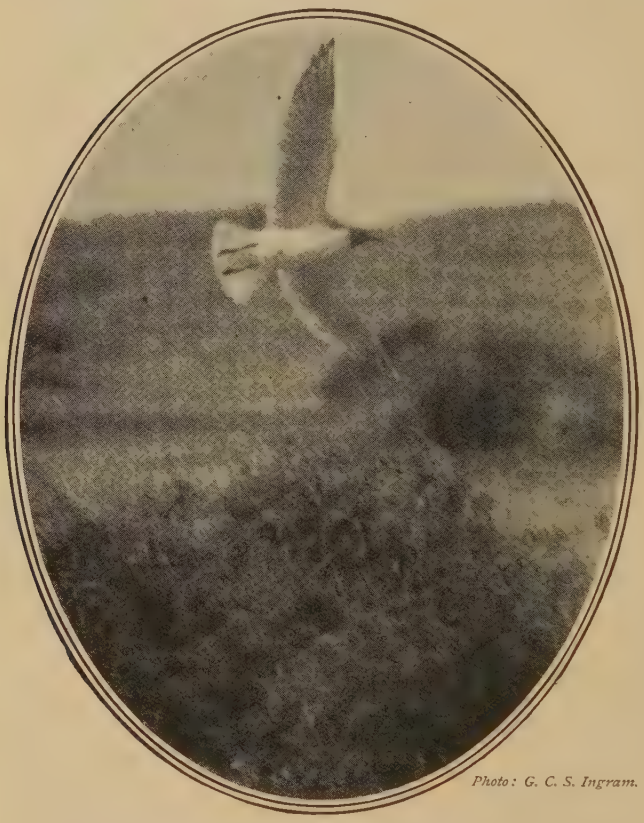


*Photo: G. C. S. Ingram.*

The flight of the Gull is so buoyant and prolonged that he seems to have an inexhaustible power of sustaining himself in the air—

The other quality is that the best kind of pleasure in outdoor nature does not depend on novelty, but upon enjoying things which recur in the seasons of the year. Every season of the year brings its own aspects of beauty or its own subjects of interest. They recur year after year; it is precisely because of this that they become increasingly familiar, and we look forward to them every year. If you wish to cultivate pleasure there are three parts of it to be cultivated. One is anticipation, another realization, and the third is retrospect. You can only have perfect anticipation of pleasure if it is a pleasure you have enjoyed before, so that you know before it arrives exactly what it is like and the sort of feeling you are going to get. Outdoor nature has a succession of seasons, and every year they bring round the same procession of beauty and interest. I am going to illustrate these general propositions from the study of birds, but, please, do not think I am going to give instruction to you about birds. My own knowledge is not that of an expert. Like many people who have been at the mercy of public life, which is a very tyrannous affair, I have passed the age of 60 and still have such deficiency of information that I am not really capable of giving instruction about anything. What I would like to try to convey to you, having had much pleasure myself in the observation of birds, is that you can get pleasure from observing them.

The word "consider" is used in the Bible in just the same sense that applies to watching objects in nature; the sense of giving attention in order to appreciate and admire. "Hast thou *considered* my servant, Job?" "*Consider* the lilies of the field." I want you to *consider* with me certain birds and certain aspects of them in order that we may understand, appreciate, and admire them. Of course, there are some people who take no pleasure in birds; they have not the capacity for doing so. But it is known to everybody that to a large number of people birds are a source of very great interest and pleasure. Why is this so? Because they have certain remarkable and attractive natural qualities. First of all, there is the power of flight, in itself a thing worth considering. The flight of different species of birds, the manner of their flying, differs so that an expert can tell by the manner of a bird's flight what species of bird it is. There are all sorts and manners and ways of flying amongst our common birds, from the buoyant and prolonged flight of the common gulls down to the rising and falling flight of the woodpeckers, which seems to be so precarious that you doubt sometimes whether the woodpecker will be able to fly to the next tree. On the other hand, if you will lie on your back on a fine day you may see gulls sailing high in the air, without apparent effort or movement, as though it was not necessary for them to descend at all, and between these two—the apparently inexhaustible power of the gull to sustain itself in the air, and the rising and falling flight of the woodpecker whose wings are weak—

*Photo: Capt. C. W. R. Knight.*

—while the rising and falling flight of the Woodpecker seems so precarious that one wonders sometimes if he will ever reach the next tree.

*Photo: B. Hanley.*

In courting time the Wild Drake wears brilliant-coloured plumage, while his mate is sober-coloured all the year round.

there are all sorts and degrees of the power of flight, and from that point of view alone our common birds become of interest.

The next aspect of birds is their plumage and wonderful variety of colouring, which presents all sorts of questions to which I can give no answer. Why should males, for instance, have a bright colour and females a comparatively dull colour, as in the case of the chaffinch and bullfinch ; while in other cases, for instance, the hedge-sparrow (which I prefer to call the dunnock because it has nothing to do with the sparrow), both the males and females are of the same colour ? And then you have a further variety of plumage when you come to the common wild duck, of which the drake is for the greater part of the year a very brilliant bird with most beautiful colours and the female is sober-coloured. But when the female is nesting the male bird, the drake, undergoes a change ; he loses all that bright colour and becomes a shabby and dowdy object, and, as if ashamed of himself, slinks out of sight, so that when the duck comes on the water with her brood of young ducklings the drake has disappeared. There are other water fowl, especially some foreign ones, some of them very nearly related to our own common wild duck, which have an entirely different plan as regards plumage. In some the male is brilliant, but the female is also brilliant, and where that is the case, the male bird is allowed to retain the brilliancy of his colour all the year round. In other cases the male bird is sober-coloured like the female, and he retains the same colour all the year round. And there is this curious accompaniment of this variety of habit, so far as I have been able to observe, where the drake remains the same colour as the female throughout the year, whether brilliant or sober-coloured, when the female has hatched her brood of young ducklings the drake helps to tend and bring them up, whereas our own wild drake and other drakes which are brilliant at one time but dull at another, do not go with the young brood at all to help to bring them up. Why this is so I cannot say, but it is a matter of interest to find, that in some species of birds, males brilliant and females sober-coloured, in other species both sexes sober-coloured, in others both sexes brilliant-coloured, as, for instance, the kingfisher, and in some species the male brilliant-coloured for only one part of the year and sober-coloured for the other part. The reason for all these different arrangements

in the plumage of different species are subjects of speculation.

The third aspect of birds I would take is the fact that they lay eggs of such various colours and build nests of such various shapes and substance. If I had to give a prize for nest-building amongst our common birds, I would give it to the long-tailed tit, which is a bird distributed over the whole of Great Britain. You meet with it frequently, from Sutherland to the South of England, in every county where I have been and where there is anything like a reasonable amount of plantation. It builds a most elaborate nest, and the whole time taken for the building of the nest and the hatching of the eggs and the rearing of the young is a very long one—much longer than is the case of any other British bird I know. When I was in office I had a cottage in the country to which I went at week-ends, and one Sunday morning, about the middle of March, I observed from the window a pair of long-tailed tits building their nest in a sweet-brier hedge. I went out and looked at the nest; it was then like an ordinary nest—cup-shaped. A long-tailed tit is not content with that, but it builds a nest like a bag with a hole near the top. Every week I went down there the building and business of the nest was going on. It so happened that the 19th of May that year was a Sunday, and I was at my cottage. It also happened that that particular day, about noon, was the time when the young birds first came out of the nest. It also happened that I was standing close by the nest at the time when the little birds first came out of it. Thus you will see that that pair of long-tailed tits required about two months and a half from the time they began to build their nest to the time the young came out of it. During all those weeks, when I could be there, the nest was a subject of interest to me, and many of you living in the country may have the same experience provided that you will yourselves, and are able to induce other people to, observe the rule not to disturb or destroy.

Long-tailed tits are particularly interesting from another point of view. The birds

*Photo: Stanley Crook.*

The Sheldrake, on the contrary, wears much the same costume as his wife, and, like her, moults only once in the year.

go in a company and the brood remains together all the autumn and winter, but early in March they separate in pairs, and if you will look closely you will see about that time that they have some little nesting material in their beaks, and if you watch them you will see them going to the nest and you can locate it. Sometimes it is rather high up in the fork of a tree, generally oak or ash, but as often as not it is only four or five feet from the ground,

*Photo : Henry Irving.*

A Wren will often build more nests than are needed for its eggs. These may be used as bedrooms during autumn and winter.

in a gorse bush or an ordinary hedge. Whether they think they are so small that you do not see them, or whether they are so intensely busy in their work, it so happens that they are not at all shy, and you can stand at a distance of three yards from the nest quite openly and watch them build. You will see first one bird and then the other get into the nest when it is in cup-shape and make it round and smooth by rubbing its breast round and round against the wall of the nest. You will see it arch its head over the sides of the nest and pull some of the outside over and inwards, weaving it thus ; and when the nest is completed outside, the birds will line the inside with feathers. Then, if you like, you can help in the building of the nest. If you can collect small feathers and put them close to the nest you can stand near and see the long-tailed tits take the feathers that you put for them and use them in their nest building. When the young birds have fledged you can, without doing any harm, take the nest and examine it, because I have never known long-tailed tits use their nest a second time. I have been told that the feathers used in the lining of a long-tailed tit's nest have been counted to number more than 900. That seems incredible ; I have not verified it, but any of you can do so. It does not do to take every nest after the birds are fledged, because some of them are used again. I have known a blackbird rear two successive broods in the same season in the same nest, and after that a pair of pied wagtails took the nest, made a new cup in it, and reared their young in it.

Next let us take an instance of a bird which builds not only one nest, but more than one. The common wren often builds more nests than are used for eggs. The nest that is used for eggs is lined with feathers, but one or more nests are often built apparently with equal skill, except that they are not lined with feathers, and have no eggs put into them. These nests are often referred to as "unoccupied dwellings," but it is not an accurate description. I found one of these nests near my house one summer, and in the autumn and winter I used occasionally to go after sunset and look at the nest, and whenever I went a single wren came out of it. So it was quite clear that that particular nest, though not built for eggs, was used by a wren as a bedroom through the autumn and winter, though I cannot be sure whether it was the same wren that built the nest.

Next I come to a less cheerful subject in the way of nests. If you study the

*Photo: Henry Will[illegible]*

**LONG-TAILED TIT AND NEST.**

The Long-tailed Tit is a bird-architect of the foremost rank. Its nest is delicately woven, roofed over, and lined with feathers.

habits of birds you will find at one end of the scale what I would call the creditable, and at the other end the discreditable, aspect of a habit, and at the discreditable end you will generally find the cuckoo. Please do not think that I do not like cuckoos. I am very fond of them, but I can only defend my liking for cuckoos in the way that I have heard some people defend their liking for a somewhat disagreeable friend. They usually say, "I cannot help liking him, I know him so well." As you know, the cuckoo has no nest of its own. It uses other birds' nests, it does not sit on its own eggs, and the young cuckoo turns the other birds out of the nest. Some thirty years ago, when I was in office, I found at one week-end a dunnock's nest with a cuckoo's egg in it. Close by I found a whitethroat's nest with eggs. I came down at the end of the following week and visited both nests to see how they were getting on. In the dunnock's nest I found lying there at the bottom a young cuckoo, naked, blind, hideous, and apparently helpless. I then went to look at the whitethroat's nest and

*Photo: F. T. Newman.*

If an egg be taken from a neighbouring nest and dropped in beside the young Cuckoo, one may see for oneself the little monster in the act of ejecting it. Here is a newly-hatched Cuckoo in a Hedge-sparrow's nest from which he has just displaced an egg.

found that there were recently hatched young birds in number corresponding with the eggs I had seen there a week before. I borrowed, temporarily, one of the little birds from that nest and put it in the dunnock's nest with the little cuckoo, and saw that apparently helpless hideous thing turn the little whitethroat out of the nest. You can try this for yourselves; and if you cannot find a newly-hatched bird to put in with the cuckoo you can make the cuckoo perform by making a small piece of wool into a ball very lightly and loosely made about the size of a recently hatched little bird. You can now see the cuckoo's methods of procedure extended on a film, and the experiment I have mentioned can be made by anybody who can find a young cuckoo in a nest, and then you can watch it repeat the performance for yourselves; you can do this provided you use a certain amount of tact without disturbing either nest; if you use sufficient tact and care you can do it without injury to any of the objects on which you are experimenting.

*Photo: M. H. Crawford.*

The close-hidden nest of the Whitethroat. The bird has earned the name of "Nettle-creeper" because of its habit of frequenting the lower parts of hedges.

*Photo: Seton Gordon, F.Z.S.*

Some species of birds are out-and-out criminals, and would be condemned by a jury of birds themselves. Prominent amongst these is the Common Gull.

# 15.—BIRDS WITH A BAD REPUTATION

By AUDREY SETON GORDON, B.A., M.B.O.U.

UNFORTUNATELY these are many, but in certain cases, perhaps, the bad reputation is hardly justified. Very often, when considering the harmfulness or otherwise of any particular species, only the damage it works is mentioned, and no thought is given to the counterbalancing good it may do in keeping down insect or other pests. However thoroughly bad a species may be, it is always dangerous to attempt its complete extermination, for this inevitably tends to upset the balance of nature. For there is no doubt that there *is* a very finely adjusted balance in the numbers of all species of birds and animals, and if the normal prosperity of any one of them is artificially interfered with by man, the consequences may be more far reaching than we can perceive. It is well known that ravages of insect pests almost always occur in forests or fruit-growing districts when there is a scarcity of insectivorous birds, such as the tit tribe.

It is said that the fly which causes such great mortality among sheep in hill districts by means of its larva or maggot has increased to an enormous extent owing to the steady decrease of such birds as lapwings and skylarks, which fed largely on the injurious grubs. Grouse disease has appeared only since the ruthless campaign against so-called "vermin."

The problem of any bird's utility to man or the reverse is a very difficult one, and must lead to much controversy. In the end it involves also philosophical questions, such as "Is the world made for man's happiness and prosperity only?" "Have not all birds and animals an equal right to live and increase?"

Such weighty problems are beyond the scope of the present article, and it is proposed to deal only with those birds which are undoubted criminals, or have a bad reputation amongst other birds; in fact, those species which would be condemned by a jury of birds themselves.

First and foremost of these out-and-out criminals are certain members of the gull tribe. I am afraid I must admit that, with the exception of the kittiwake, all British members of the gull tribe have an unenviable reputation among birds. The largest, most powerful, and probably the most wicked of gulls is the great black-back. Luckily it is not common—generally not more than two or three pairs nesting together. It is distributed over all the British coasts, but is most numerous on the west and north coasts of Scotland; the usual nesting haunt is a rocky coast line, or small island.

The cock is larger than the hen, but otherwise the sexes are alike. The powerful pale yellow bill (with a red spot near the tip) and the piercing hazel eyes with their red rims somehow give the bird a highly criminal expression when seen at close quarters. This great gull will kill a full-grown puffin and eat his entrails! He makes short work of a sickly lamb or even sheep, pecking out the eyes and tongue—but would not attack a healthy lamb. Every kind of egg makes him a welcome feast, and he is able to swallow them whole with the greatest ease. On one occasion when I was in a hiding-tent photographing a great black-backed gull on her nest, I saw another of the species sitting on a nest near by being attacked by a roving great black-back. A furious battle ensued, and in the end the sitting bird was driven away mortally injured while the attacker sucked her three eggs!

A bird which will prey on its own species in this manner must indeed be a deep-dyed criminal!

These gulls are especially fond of young ducks of all kinds, and will swoop down and pick them out of the water, and swallow

*Photo: Seton Gordon, F.Z.S.*

In spite of its dove-like appearance the Common Gull is a bird about which it is hard to find a good word to say.

them whole while on the wing! A great black-back has been seen to pursue an almost full grown red-breasted merganser—a duck of about the same size as a mallard—tiring it out by forcing it to dive repeatedly, and then killing and eating it.

Even as a parent little good can be said of this gull, for it seems thoroughly bored by its domestic duties, and callous in its treatment of the young.

The great black-back is to a certain extent migratory, but may be seen on the British coasts throughout the winter, generally beside estuaries. It is probable that those individuals nesting in the north and west of Scotland fly south at the approach of winter, to England and Ireland, their places being taken by those that have bred farther north, in the Shetlands, perhaps, or in Norway.

The common gull is another member of the gull tribe about which it is hard to find a good word to say. Its appearance and expression are positively dove-like in beauty and innocence, but what awful wickedness this deceptive exterior hides!

Like the greater black-back, it is most numerous in the north and west of Scotland, and breeds very sparingly in England. In winter, however, it is spread over all the British coasts. In Scotland it generally nests upon islands or near the sea, but sometimes high up amongst the hills on the shores of some remote loch nearly 3,000 feet above sea-level.

During a summer spent in the Outer Hebrides I had an opportunity of observing closely the habits of this gull during the breeding season. Almost all the fresh-water lochs near the sea had colonies of common gulls nesting on their shores and islands. A few Arctic terns, many dunlin, certain oyster-catchers, and a good number of the rare red-necked phalarope nested also round these lochs, and in early July broods of mallard, tufted ducks, mergansers, and other water-fowl appeared on the waters.

All these chicks and eggs were considered fair game by the marauding common gulls. Should any person or cart or herd of cattle approach the nesting-ground, several common gulls would at once follow the in-

*Photo: Seton Gordon, F.Z.S.*

The largest, most powerful, and probably the most wicked of gulls is the Great Black-back. This gull will kill a full-grown puffin and make short work of a sickly lamb.

**THE HOODED OR GREY CROW.**

He is an arrant thief, and devours enormous quantities of eggs. This impudent Crow has been known to visit even an eagle's eyrie and suck the eggs during the absence of the owners.

truders, knowing that, on the approach of danger, all the sitting birds would leave their charges. The moment an unfortunate dunlin or other bird was put off its nest, down would swoop a gull and swallow the entire nestful of eggs, not even waiting to break the eggs, but gulping them down whole! Their boldness was amazing: they would swallow eggs or young within a few yards of the human or bovine trespasser who had unwittingly caused the rightful owner to leave her treasures unguarded. When the chicks were hatched—those few lucky enough to escape being swallowed as eggs—it was pitiful to see the beautiful young dunlin and phalaropes disappearing down the wicked gulls' throats.

*Photo: Seton Gordon, F.Z.S.*

A philosophical young Raven. Does he deserve his bad reputation? It is not proved that he does much harm to other birds. For food he prefers carrion.

On the sea-shore near by, a colony of lesser terns nested, and these also were preyed upon by the common gulls, so that not a single chick was reared during the whole season. The common gulls seemed to become most destructive when their own young began to get big and domestic cares no longer occupied them so fully.

The lapwings nesting on the grass-lands near did their utmost to annoy the criminals, chasing them vigorously each time they appeared on their own particular beat, yet even they often had their eggs and young snatched away from them when their backs were turned.

The small harassed dunlin at times pursued the gulls, but their pursuit was usually ineffective. Not so that of the still smaller red-necked phalaropes, who furiously darted at any trespassing gull.

The lesser black-back, black-headed, and herring gulls at times show criminal propensities, but vary in different colonies and in different individuals. A few members of a colony may become out-and-out criminals—like certain lions which become man-eaters—and live entirely upon eggs and young birds, while other members of the same colony keep to virtuous paths.

The crow tribe all have a bad reputation amongst other birds, whether justified or not. The raven, for instance, largest and most powerful of the genus, is hated by other birds and always driven away if possible. But it is not proved that he does much harm to other birds. For food he prefers carrion—dead or dying sheep, lambs, or cattle—but he may occasionally suck eggs and eat young birds.

The hooded or grey crow is a far more destructive character, and is detested by all birds. He is an arrant thief, and devours enormous quantities of eggs. He is plentiful all over northern Scotland during the breeding season, and often nests on sea-cliffs or upon islands, working great havoc among the eggs of the sea birds. The crow family when taking eggs usually carry them to water before breaking and sucking them, and on a certain island off the west coast of Scotland, tenanted by many sea-birds and a pair of hoodies, I found no fewer than ninety-five eggshells beside the hoodies' pool! This impudent crow has

been known to visit even an eagle's eyrie and suck the eggs during the absence of the owners. Young birds of any sort do not come amiss to this villain, who carries them off, tears them in pieces, and devours the spoil on a neighbouring stone.

The carrion crow is in England what the hoodie is in Scotland, but though he has an equally bad character, the species is not so numerous. The hoodie or grey crow and the carrion crow are very closely related, and in a nest built on a large silver fir in Aberdeenshire the hen was a hoodie, the cock a carrion crow.

The remaining member of the true crow family, namely, the jackdaw, is not so bad a character, and is not pursued by other birds, though no doubt he sucks eggs when he gets the chance.

The raven, hoodie, and carrion crow are all regarded as deadly enemies by the bird world. There is no question that the hoodie and the carrion crow are as bad as their reputation makes them out to be, but probably the raven is pursued and harried by other birds only because he is not distinguished from the more wicked carrion and hooded crows.

Another bird which is undoubtedly much disliked by other birds is the heron. The reason for this is not easy to understand, because, as far as at present known, it is harmless to the bird world, and leads a quiet, contemplative life, feeding entirely upon aquatic creatures. It is possible that this dislike may be caused by its disturbing habit when leaving its fishing and taking wing, of uttering a raucous shriek, and by its rather uncanny appearance.

The tribe of the hawks is regarded by all birds as dangerous, and rightly so. But it would not be fair to class them as criminals, for they prey on and attack chiefly adult birds, which they kill in the open in fair fight. They do not, as a rule, degrade themselves by carrying off innocent nestlings and sucking eggs. The larger birds of prey, such as the peregrine falcon, buzzard, and golden eagle, are, to a certain extent, enemies to game birds, and to small birds such as the meadow pipit and the skylark, but their extermination would doubtless lead to other evils befalling our game birds—such as disease, for it must always be borne in mind that an eagle or a buzzard will attack a weakly grouse in preference to a healthy one.

*Photo: Seton Gordon, F.Z.S.*

The Heron is undoubtedly much disliked by other birds. The reason for this is difficult to understand, for he leads a quiet, contemplative life, feeding entirely upon aquatic creatures.

The young twig-like caterpillars of the Swallowtail Moth spend the winter sleeping on the bare ivy-boughs. Their resemblance to the real twigs is greatly increased by contrast with a hairy Tiger Moth caterpillar who visited the camp in January (× 2).

# 9.—THE CAMP OF THE SAMBUCARIAS

By M. H. CRAWFORD

With photographs by the Author

THE original camp was in a honeysuckle hedge, where a swallowtail moth had laid her eggs in the late summer. But the supply of food leaves failed while the weather was still warm and before the young sambucarias had had quite enough to eat. This was the reason why half a dozen of them transferred themselves to an ivy twig that conveniently jutted out near a leafless honeysuckle branch.

Henceforward these six caterpillars lived amongst the ivy leaves. At the beginning of winter they were each about an inch long, dark greenish brown in colour, streaked with small lines along the side, and bearing ridges and tubercles; the result was that they resembled tiny twigs, their tubercles and markings corresponding exactly to the little projections and the indistinct lines on the twigs. One would have imagined they knew of this resemblance and did what they could to accentuate it, for, when they were

In April the caterpillar made the outer casing of its cocoon out of such materials as scraps of leaves, lichen, cobwebs, and nondescript rubbish that had blown up from the ground. (Life size.)

resting and not eating, they assumed the precise positions of twigs. This was easy to do; firstly, because they had no legs along the middle part of the body, only at each end; and, secondly, because they possessed immense muscular strength. They could stand upright for hours, their heads erect, and their legs, projecting just underneath, looking exactly like little stiff, brown leaf-buds. This was the position usually assumed when the feeding time was over and they had settled down for the winter; two or three showed a hungry restlessness and wandered about in search of food long after the others had literally gone to sleep. But finally they, too, gripped a branch firmly with their hind claspers, threw up their heads in the air, and, after a little preliminary waving about, went to sleep.

This was how the camp looked in the early days of winter—six small, twig-like caterpillars motionless amongst the real twigs. For a month or two the camp had a visitor in the shape of a young cream-spot tiger-moth caterpillar; it also was hibernating through the cold months, but long before spring came it had departed to seek a congenial shelter amongst low-growing plants. While it stayed, however, it greatly increased by contrast the likeness of the sambucarias to the brown ivy branches.

With an apparent foresight they had chosen for their home ivy branches that were quite destitute of leaves. Perhaps this was why the tits and other insect-eating birds never troubled them. Usually there were tiny insects of some sort and at some stage to be found amongst foliage, but there was very little insect food on bare branches; and so the birds let the sambucarias alone. In another way also the caterpillars outwitted the tits—when they happened to want a change of position they relaxed from their rigidity after dusk and not during daylight. It was quite by chance that I discovered them practising this unconsciously cunning trick. I visited them one night with a lantern, and an amazing sight revealed itself. A fine dense network of silk surrounded and

The two caterpillars on the right failed to pupate; the one on the left made a splendid cocoon, and emerged three weeks later. Note the close network of silken threads spun round the caterpillar's body. At this stage they are about three inches long.

Suspended from a twig of ivy the shape of the chrysalis shows clearly when the outer coverings are removed (× 1½).

roofed in the camp. This grey silk tissue was absolutely invisible in bright daylight, but it showed now like a sheeny globe suspended amongst the ivy, and inside the globe were the caterpillars. Not only were they encased in their fragile home, but they were all connected together. Every tiny waving head was pulling incessantly at threads attached to its companions, and just then they seemed to be exchanging numerous communications, for all the heads were swaying about, and the caterpillars were looping over each other's bodies. Sometimes two or three of them would clasp each other tightly with the front claspers, and then a seemingly strenuous and painful struggle would ensue. For several seconds they clasped and tugged and pulled, and then, quite suddenly, their hold would be relaxed. But, all the time, they never left their silken cage; they writhed and looped and clasped, but not one put even its head outside. It is quite possible that all this silk that enmeshed them was an extra protection against the birds, for no bird, with the exception, perhaps, of the cuckoo, who does not object to caterpillars' hairs in his throat, would have willingly swallowed the mesh in order to get such a small, thin, wiry larva as a sambucaria.

With the very first breath of spring a change came over the camp. The inhabitants began to leave the shelter of their almost impalpable and invisible balloon and to search for food. That they did this was evident from the fact that they began to grow; but they must have gone food hunting at night, for they were always at home during the day. They grew visibly from day to day, and by the first week in March were eating heartily and openly of the ivy leaves. They also changed their skins, and after this operation they all appeared much bigger, browner and twiggier.

By the middle of April three of them were nearly three inches long, and were beginning to prepare for summer. Leaves as food were

There is no stranger object than a newly emerged Swallow-tail, with its enormous head and thorax and bulging eyes. It gets away from its pupa case (seen hanging on the right) as quickly as possible, and keeps its body suspended so that the undeveloped wings hang downwards (× 1½).

losing their attraction. Then, one morning, one caterpillar collected a scrap or two of a decayed leaf and fastened them round its body. Before the day ended it had made itself a sort of sheath out of numerous odds and ends; these, looked at under a magnifying glass, consisted of spider's web, lichen, bits of skeleton leaves, and minute, freshly bitten morsels of ivy leaves, all woven together with strong caterpillar silk. Inside this sheath it was wriggling and twisting. A close examination revealed innumerable fine threads that connected it to the twig from which it was suspended; threads also were fastened to side branches and twigs. By the next day it was, as a caterpillar, unrecognizable. It was more like a small collection of fine rubbish that had been blown up from the ground and had got caught amongst the ivy; but a very slight touch set the caterpillar inside wriggling and protesting violently. Its two companions were much more deliberate; they fasted for two whole days before commencing preparations, and even then they went very slowly. By the time they had partially concealed themselves they had grown quite shrivelled and thin; one hung from a branch by a bunch of threads, the other lay along the branch, and, as it worked very slowly, each movement of the head and front feet, weaving and spinning the silk, was seen quite plainly. It was evident, too, that this

Like a little white shadow the young Swallowtail hangs in a dim corner, waiting for its wings to develop and dry ( $\times \frac{1}{2}$).

With wings fully developed and strong, the Swallowtail for the first time comes out into the moonlight. The wings are spead out and flattened, displaying the characteristic transverse lines ($\times 1\frac{1}{2}$).

caterpillar had a liking for tiny chips of wood and bark, and one photograph (p. 329) shows a number of these chips being fastened together.

Trouble and disaster and sudden death awaited the other three members of the little colony. Two failed at the last moment successfully to complete the process of cocoon making, and the third disappeared entirely ; probably it was caught and eaten by a keen-sighted bird. Pupation seems to be a test of fitness, and many larvæ die under it. The two who failed apparently had not sufficient strength to carry on ; in the case of one, at any rate, a defective constitution showed itself at the crucial moment, and it hung, limp and dying, amongst threads of its own weaving. The other, coming along and finding a mass of silky, cobwebby material out of which its comrade had weakly fallen, climbed down to investigate, discovered the dying one, and ate part of it. This was clear evidence of abnormality. The cannibal never even tried to make a cocoon, but slowly shrivelled and died.

Swallowtail moths are amongst the very loveliest of the early summer moths. The wings are a delicate pale sulphur yellow, crossed by distinct lines of olive-green, two on the fore-wings and one on each hind-wing. There is also a pointed tip on each hind-wing like a swallow's tail. Legs and antennæ are pale yellow also, and the whole appearance of the moth is one of the most delicate beauty.

But there is no stranger object than a newly emerged swallowtail. As the strong yellow legs break out of the tight, enveloping parchment-like pupa case, the head and thorax seem enormous, as well as the bulging eyes. The whole body, the wings and the antennæ are palest yellow, covered with fine down. The newly emerged moth gets away from the pupa case as quickly as it can, taking care to keep its body suspended so that the undeveloped wings hang downwards.

The first few hours of a moth's existence are full of danger, for any bird would snap it up on sight, and the moth cannot possibly escape either by walking or flying. Hardly anything will induce a newly emerged moth to move till its wings are fully developed. But, in spite of the swallowtail's pale golden wings, it is not conspicuous. I have seen it resting, during the day, on a fence, when it was very difficult to detect it. The spread-out, flattened wings, the wavy, transverse lines, and the whole irregular outline serve to make it almost imperceptible.

In spite of its pale golden wings the Swallowtail is not really conspicuous in the daytime .The pointed wings and transverse markings serve to break up the outline (× 1½).

*Photo: E. Step, F.L.S.*

The nest of the Red Wood Ants is a hillock of dead pine needles, twig debris and old cones, a yard high, which looks like a rounded heap swept up by some tidy woodman.

# 10.—CITY BUILDERS IN THE PINE WOOD

By EDWARD STEP, F.L.S.

THE birches on the heath are breaking out into delicate new foliage, and the male catkins that have been conspicuous on the leafless twigs throughout the winter have now grown long and soft. That beautiful spring moth the orange underwing (*Brephos parthenias*) is flitting high about them; while upon the upright female catkins, on which the larvæ will feed, its mate is depositing her eggs.

Passing through the birch belt we come into one of the few woods of big pines that have survived the timber demands of the Great War. The ground is bare save for the isolated gleaming cushions of white fork-moss (*Leucobryum glaucum*); we walk upon a thick layer of dead pine needles, twig debris and old cones that, having shed their winged seeds, turn their empty scales outwards. Ahead of us is a rounded heap of such rubbish, a yard high, looking as though a tidy woodman had swept it up in readiness for carting away. But as we get nearer to it we notice that its surface is in motion, and a stream of something dark and shiny is pouring out of the top and down the side. Still closer, we find that the stream consists of large red-brown ants, and that at the base of the hillock it divides and runs off in thin lines in several directions; the rustle of ants' feet on the dry carpet is distinctly heard.

The hillock is the nest of the red wood ant (*Formica rufa*), the largest and most conspicuous of the British ants; the insects have been roused to activity by the warmth of the air and the brilliance of the spring sunshine. They are on the war-path seeking for small caterpillars and other insects that may be converted into food; they are also visiting aphis colonies, and will return to the nest with their hind-bodies

distended by the so-called honeydew that the plant lice excrete. It is not a difficult matter to scoop up a few of these ants in a glass-bottomed box, where, when they have quietened down, we can observe their forms more precisely than is possible when stooping over the nest. Moreover, the latter method of observation clearly is objectionable to the ants, for many of them partially erect themselves and eject from their hind-bodies invisible jets of acid which burns one's skin. Others swarm up the observer as they do upon a tree trunk, and then, finding that the supposed tree has fleshy parts, they try to nip particles out of him with their capable jaws.

WOOD ANT—WINGED FEMALE.

WOOD ANT—WORKER.

Photo: E. Step, F.L.S.

FEMALE WOOD ANT AFTER THROWING OFF WINGS.

On a suitable day in spring or early summer the winged ants creep out of the nest, fly off, and pair, but the males do not return. After a successful marriage flight, the first business of the female is to get rid of her wings. The workers, besides doing all the necessary enlargements and repairs, feed, cleanse and transport the grubs.

Those we have trapped can be observed without any discomfort. Having made several gatherings in separate boxes we are able to see that there are differences between them—some slight dissimilarities in size, form and colour. The best method for obtaining an assortment, however, is to plunge the arm boldly into the central cavity of the nest and drag out a fistful of the material, drop it on a sheet of paper and pick up the insects as they scurry off. Probably this method will secure a number of genuine ants' eggs and the pseudonymous "eggs," which are really cocoons containing pupæ. The grab method is almost heroic, for it is not to be accomplished without many bites and a burning of the flesh by formic acid, the fumes of which rise pungent from the broken ant-hill.

If the season be sufficiently advanced our haul may include winged males and females, females without wings and wingless workers. The winged individuals are waiting for auspicious conditions for their only flight. The male may be known by his colour, which is a blackish brown that appears black except on a close inspection; but his legs are dark red, and he is sparingly clothed with fine, short hairs. His hind-body, which is broadest at its base, is only slightly shiny. In the female the colour is red-brown, and the polished hind-body is very convex and broadest in the middle; the legs are red clouded with brown. The head and fore-body in both sexes are lon and dull. The mass of the population of

Photo: A. Harold Bastin.

Worker Red Wood Ants are undeveloped females. They are supposed to have evolved a kind of "deaf and dumb" or "touch" language by using their "elbowed" antennæ for communicating with each other.

*Photo: Hugh Main, B.Sc., F.E.S.*

On closer inspection the Ants' nest appears to be in motion, for a stream of something dark and shiny is pouring out of the top and down the side.

*Photo: A. Harold Bastin.*

The Red Wood Ants' nest is not built merely for a season, but is added to year by year, and will shelter many generations for an indefinite number of seasons.

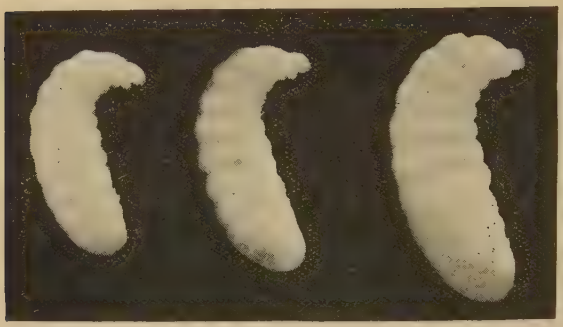


*Photo: A. Harold Bastin.*

The larva of the Red Wood Ant (magnified) showing successive stages of growth.

the nest consists of workers which are sexless, or rather they are females without the capacity to produce eggs. They are of two classes; the larger is at least twice the bulk of the smaller workers. Both are recognizable at a glance by the general dullness of their surface, with the exception of parts of the red head. The red fore-body is much narrower than in the sexes, where it has to support wings as well as legs, and this accentuates the breadth of the head. The almost round hind-body is dark brown.

Wherever one comes upon these huge nests in a wood, there will be workers in plenty everywhere, patrolling the ground and ascending the tree trunks. In the latter case it will be found that there are two well-defined streams, one going up, the other coming down; and those descending have their hind-bodies more distended than those ascending. Somewhere up amongst the foliage of that tree there are great numbers of aphis, and the constant stream of worker ants is engaged in collecting the honeydew from them. When gorged with this they return straight to the nest, and regurgitate it directly into the mouths of the helpless grubs. Even the workers that appear to be wandering aimlessly over the ground are busy searching for food or for building materials. Apart from necessary extensions to meet the needs of a growing community the structure also requires reinforcement, for there are among the numerous alien lodgers in the nest some that feed upon its building materials; and there is a certain amount of natural decay. If watch be kept in the neighbourhood of the nest, some of these returning foragers will be discovered, one perhaps dragging a caterpillar along, another hauling a bit of twig that is enormously disproportionate to its own size.

Among the material pulled out from the interior of the nest were certainly a few of the abundant eggs, which the workers carry in their jaws each day to the higher cavities and passages of the nest that they may benefit from the warmth of the sunshine. In due course these eggs hatch, and there issue from them the helpless, legless grubs that require incessant attention and receive it from the assiduous workers, who feed, cleanse and transport them as may be necessary. When they have reached their full development as larvæ they exhibit one power of self-help: they spin a tough cocoon around themselves in which they pass into the pupal condition. It is these cocoons with their contained pupæ, dead and dry, that the bird fancier knows as "ants' eggs"; these are bought and sold as such for the food of insectivorous birds, gold-fish, etc.

From these cocoons, after an interval of about a month, the perfect ants emerge—wingless workers and winged males and females. On a suitable day in spring or early summer the winged ants creep out of the nest, fly off and pair. The males do not return. After a brief period of winged enjoyment they die or are eaten by birds,

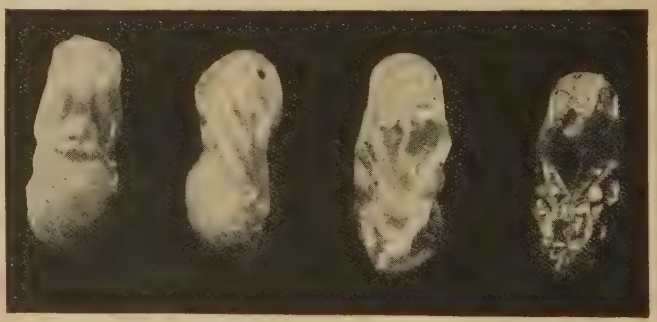


*Photo: A. Harold Bastin.*

Pupæ of Red Wood Ant nearing the time when the insect will emerge. The parts of the insect (eyes, &c.) can be seen through the delicate skin.

reptiles or fishes; indeed, the same fate happens to many of the females. Many of the latter after fertilization may descend in the neighbourhood of the old nest, in which case they are seized by workers and carried inside with great respect. Others seek shelter under clods of earth, and may get into a passage leading to a nest of the small black ant (*Formica fusca*). But the first business of the female after a successful marriage flight is to get rid of her wings, which are detached at a transverse joint close up to their base. In some species a fertile female will found a new community, acting as a worker and attending to her first batch of eggs and larvæ; but the female wood ant appears to be incapable of founding a colony unaided, so if away from her own kind she will crawl into a nest of the small black ant.

She may be attacked, perhaps killed, by the black workers; she defends herself and may destroy her smaller assailants. On the other hand, she may be made welcome straight off and led into the interior chambers. In this case, she lays a batch of eggs, and these and the larvæ that hatch from them are tended by the black workers. Several other batches of eggs are deposited at intervals. As the majority of her offspring develop ultimately into workers bigger and more powerful than the black ants, it is not long before the nest becomes a distinctly wood ant community.

*Photo: A. Harold Bastin.*

An enormously enlarged illustration of a Wood Ant—one of the assiduous workers whose labours serve to build up the large piles of pine needles, cones and twigs found in the woods.

Often an old-established wood ants' nest is connected with branch nests at a little distance, and intercourse may be kept up either by paths above ground or by underground passages, or both. Such a nest is not constructed to serve merely for a season, as are those of the wasps and humble bees, but for an indefinite period; it will almost certainly shelter succeeding generations through many years. Neither is the community the offspring of one female as amongst wasps and bees; in an ant city there are many mothers. This, by itself, makes for the permanency of the nest, because, where only one fertile female is present, an accident,

*Photo: A. Harold Bastin.*

Greatly magnified photograph (from above) of a Wood Ant in a threatening attitude. The abdomen, from the tip of which is squirted formic acid, is turned in the direction of the foe.

disease or old age may terminate growth and bring about the rapid decay of the community. With the older females constantly reinforced by their daughters, the birth-rate is kept up and the vast army of workers augmented.

This form of socialism explains, perhaps, why there is no great number of distinct communities in the wood. The newly matured winged ants leave the nest solely for the purpose of mating, and may find partners from a neighbouring community, and so give new vigour to the strain. The fertilized female may return to the nest where she was born, if she will; so that there is no incentive to the founding of new colonies as in the case of species where the female has full powers of providing unaided for her progeny.

The workers are possessed of

*Photo: A. Harold Bastin.*

Interior of a nest of Wood Ants, showing galleries and passages communicating with branch nests; also the larvæ popularly, but wrongly, known as "ants' eggs."

amazing and tireless industry. They act as nurses, caring for the eggs and facilitating their hatching; feed and clean the larvæ, enlarge and repair the nest, and scour the surroundings far and wide for food and building material. They may take a very erratic course in their searches, and if you or I adopted similar divagations in a wood we should probably lose our bearings very soon; but the ant has a keen sense of orientation, and, its quest ended, it returns to the nest without uncertainty.

It must not be supposed that the wood ants' nest is a merely superficial structure—a reasonable inference from its considerable elevation and its many visible exits and entrances. Below the surface level it may extend into the ground as far as its cupola rises into the air. And so, for the varying conditions of temperature, night and day, summer and winter, the ant city is a suitable dwelling-place for its inhabitants in all stages of growth.

Ants are not the only living creatures that inhabit these structures. There are many species of beetles, flies, moths, etc., that spend at least part of their lives there; there are also two or three little-known spiders and a white woodlouse that is blind, and lives nowhere else but in ants' nests. A few of these are true commensals, conferring some benefit upon their hosts in return for their lodging; others are actual parasites, feeding upon the eggs and larvæ of the ants, and a third class are mere scavengers, feeding upon ant waste.

*Photo: E. Step, F.L.S.*

An Ants' nest in the heather in process of construction. Wherever the site is pitched, the Ant, despite its tortuous journeys for food and building material, always returns without hesitation.

*Photo: Frances Pitt.*

The home or "fortress" hillocks of the Mole, which are such familiar landmarks in districts where the creature abounds, are formed when the Moles are burrowing near the surface; the loosened soil is pushed upwards at intervals by the Mole's head.

# 6.—A VELVET-COATED TUNNEL-MAKER

By W. S. BERRIDGE, F.Z.S.

THE mole-hill is an object very familiar to the wanderer through the country-side; oftentimes brought forcibly to his notice as he stubs his foot into one when crossing a meadow path. Yet he seldom or never sees alive the tunneller who is responsible for them. Only at times a pathetic row of drying pelts nailed to some barn or shed gives him some idea of the form and size of this industrious little navvy of the animal world.

The mole, mould-warp, moldard or earth-caster, as he is variously called, *Talpa europæa*, to use his scientific designation, is a plump-looking and cylindrical-shaped creature that measures about five or six inches in length, with a diminutive tail that accounts for barely an inch of the total. Its short, thick neck joins the body without any perceptible constriction at the junction; and the head ends in a long, sharp-pointed muzzle furnished with a pair of tubular nostrils that are supported by a small bone at the extremity. The feet are naked and of a flesh tint, and all the toes are provided with claws; those upon the fore-feet are

*Photo: Stanley Crook.*

**COMMON MOLE** ***(TALPA EUROPÆA).***

The Mole is a plump-looking and cylindrical shaped creature measuring some five or six inches in length, with a diminutive tail that accounts for barely an inch of the total. Its feet are naked and of a flesh tint.

*Photo: S. C. Johnson.*

The Mole does not possess external ears, but its powers of hearing are very acute. Its eyes are so minute as to be scarcely visible beneath the normally bluish-grey or mouse-grey fur.

exceptionally broad, flat and powerful, while those of the hind-feet are comparatively small. The reason for this difference is not difficult to seek; the former are used by the animal for digging, and the latter serve merely as organs of progression.

The wrist, from which arises a large, curved and claw-like bone, is wonderfully adapted to the conditions of the mole's life. The individual bones which make up the part are very short and thick. The humerus (the bone of the arm that extends from the shoulder to the elbow) is also exceedingly short and stumpy, and unlike that of any other animal; while a number of small, irregular-shaped excrescences or processes arise from the surface. The breast-bone, which is keeled in a manner somewhat similar to that of a bird, extends forward for a considerable distance into the region of the neck, at the same time carrying with it the collar-bone and humerus, thereby throwing the fore-limbs very much in advance.

Many people are under the impression that the mole is blind, but such is not the case. It is true that its eyes are so minute as to be scarcely visible beneath the surrounding fur, but, nevertheless, they are functional organs of vision, even if somewhat imperfect. The animal does not possess external ears, but this peculiarity in no way impairs its powers of hearing, which are very acute.

The short and velvet-like fur, which is set vertically in the skin, possesses the curious property of not becoming ruffled, no matter in which way it be brushed; this provision of Nature prevents the coat from becoming clogged with loose soil when the animal is engaged in burrowing, and also enables it to travel through its subterranean galleries more easily than would otherwise be the case if the hair were to become disordered.

The colour of the fur is subject to a considerable degree of variation. Normally it is of a bluish-grey or mouse-grey tint, but animals with deep black, dark or light brown, silver-grey, orange-tawny, pale buff, white, or even pied coats, have been recorded.

Mole fur, or moleskin as it is more usually called, is in great demand for making up into muffs, cloaks and other forms of wearing apparel, notwithstanding its bad wearing qualities. It certainly has the advantage of being cheap (although this fact is regarded by some people as being a sufficient reason for condemning it), but, like all other furs, its price has increased considerably of late years. In pre-war days the skins fetched about one or two shillings a dozen, while in the year 1919 they commanded as much as two shillings each. To-day the price has fallen to about £4 10s. per hundred.

The mole has a wide distribution, its range extending from England to Central and Southern Europe, thence through Asia to Japan. It is absent, however, from Ireland.

*Photo: Capt. Cherry Kearton.*

The Mole is a voracious feeder; its staple diet consists of earth-worms (he is shown here with one in his mouth), insects and their larvæ, but he is also partial to such fare as small birds, mice and frogs.

*Photo: Capt. Cherry Kearton.*

Young Moles are less than two inches long at birth. For the first week they are blind and helpless, and entirely devoid of fur. Their underground nest, which is lined with grass, root-fibres and dry leaves, is quite distinct from the ordinary dwelling chamber.

In some districts the creatures are so plentiful that they prove a great nuisance; their burrows disturb and damage the roots of growing crops, and the mounds or earth-casts they throw up at intervals during their progress underground render the surface of the ground so uneven that the use of a mowing machine is made a task of some difficulty. In one respect the mole can be regarded as a friend to mankind, for its subterranean workings serve as a beneficial drainage system to the soil. The drawback to this service is that it prefers to work in light soil that does not need draining. When burrowing the mole brings its fore-feet forward to the level of its nose and then sweeps them backwards and outwards in a manner that suggests the action of a person in swimming. It is a most industrious worker, and in one night has been known to excavate passages that measure four hundred and fifty times its own length.

A curious fact in regard to moles is that, of the two sexes, the males are by far the more numerous; but why this should be is a question that is at present unsolved.

They are of a quarrelsome disposition and fight fiercely with one another, more especially during the spring months, when the males engage in furious combats for the possession of the females. When thus engaged they have been known to leave their burrows and settle their disputes in daylight.

The victor having disposed of his opponent in more ways than one—for the dead body of the vanquished foe is regarded as suitable fare upon which to make a meal—eventually settles down to family life; and at the end of April or during May the young moles are born in an underground nest lined with grass, root-fibres and dry leaves. This nursery is quite distinct from the ordinary dwelling chamber, from which it is often separated by a considerable distance. From three to five babies are the usual number to be found in a litter, although there may be occasionally more; only one brood is produced in a season. The young ones, which are less than two

*Photo: Richard Kearton, F.Z.S.*

The Mole seen on a foraging expedition, its long, sharp-jointed muzzle well down to the ground. Note that the short, thick neck joins the body without any perceptible constriction at the junction.

inches in length at the time of their birth, are both blind and helpless, and the pink bodies are entirely devoid of fur.

They grow rapidly and increase at the rate of about one-fifth of an inch a day. As they gain in size, the colour of their skin gradually changes, and at the end of the tenth day after their birth they are no longer pink but of a leaden tint. When they are a fortnight old they are clothed in a short and velvety fur ; but they do not leave their nest until they are a month old and about three-parts grown.

Moles are voracious feeders, their staple diet consisting of earth-worms, insects and their larvæ. They are also partial to such fare as small birds, mice and frogs, should the same come within their reach ; and, as already stated, they will devour the carcasses of their defunct brethren.

It must not be assumed that the mole is a glutton and eats merely for the sake of eating, for it is a known fact that it will die should it abstain from food for twelve hours, or even less. Its desire for liquid refreshment is equally as great as for that of a more solid form of nourishment ; and in order to obtain the water for its needs it will make a subterranean gallery leading to a pond or ditch, or else sink a deep shaft down into the soil.

Notwithstanding that the animal spends nearly all its time underground, yet it is quite capable of swimming should occasion arise.

It is commonly reported in old Natural History books, and even in some modern ones, that the home or "fortress" of the mole is planned upon very regular lines ; a central or dwelling chamber is encircled by two galleries, one above the other, and the lower tunnel usually of greater circumference than the upper. These galleries are connected by short passages, and several blind-ended tunnels extend from the lower one. A single passage, known as the "bolt run," leads directly from the main compartment to the various long tunnels that radiate in all directions and serve as a hunting ground for the procuring of food. Although there is no reason to doubt that the above description may be an accurate one in regard to some "fortresses," yet it is now recognized that the underground home of the mole is not built in such a precise and regular fashion as was formerly thought to be the case.

The burrows are situated at varying depths below the surface, the dispositions depending upon the condition of the soil.

In dry weather, when the earth-worms have descended low down, the moles naturally follow them ; as to the length of the tunnels, this is regulated to a great extent by the amount of food to be found, the animals having to search farther afield when the supply is scarce.

The mole-hills are formed when the animals are burrowing near the surface ; the loose soil that is dislodged during their progress is pressed upwards at intervals by the mole's head, and forms small cone-shaped heap.

*Photo : Frances Pitt.*

A close-up view of the Mole showing the short, velvet-like fur, and the exceptionally powerful fore-feet with which it digs its long tunnels.

# By-Ways of Plant Life

## 2.—THE SENSITIVE TENDRIL

By S. LEONARD BASTIN

OVERCROWDING has for long been an acute problem in the world of plants, and many and ingenious are the devices by which various species have contrived to get the better of their neighbours. Some began to stiffen their stems until they developed trunks strong enough to hold up and spread out to the sun a vast array of leaves and flowers—became, in fact, forest trees. Others spread their leaves rosette fashion, flat on the ground, and so shut off light and air from those who have approached too closely to their immediate area. Others have developed parasitical habits, and now, instead of producing leaves, or roots for themselves, send suckers into some other plant and in that way gain access to the store of nitrogen which their host has been to the trouble of extracting for itself from sun and soil.

Climbing plants, although they rely on their own efforts for the gaining of food, depend on others to give them support so that the foliage may be carried up into the air. To this end is devoted all the ingenuity (if it may not be called intelligence) that they can command. Instead, therefore, of developing woodiness and strength of stem, many climbing plants possess tendrils or "fingers" which enable them to cling on to those neighbours who are stronger than themselves.

*Photo: Henry Irving.*

All tendrils are developed from definite plant organs, leaves, stem, and even roots. In the case of the Everlasting Pea, all leaflets but two have been modified into tendrils.

All tendrils represent definite plant organs; that is to say, they are either leaves or portions of leaves, stem structures, or, on occasion, even roots. Every tendril was originally one of these organs, and in the course of its development has been modified into a climbing organ. Tendrils sometimes appear in the position of flowering shoots, and so may be regarded as modified floral branches. These will arise in the axils of the leaves as is to be seen in the case of the passion flower and vine. Such tendrils may bear leaves, or traces of leaves; now and again the vine will even bear flowers on the climbing processes. In the *Ampelopsis veitchii*, so popular as a house climber on account of its autumn colouring, the tendrils which are branched bear at the tips small adhesive

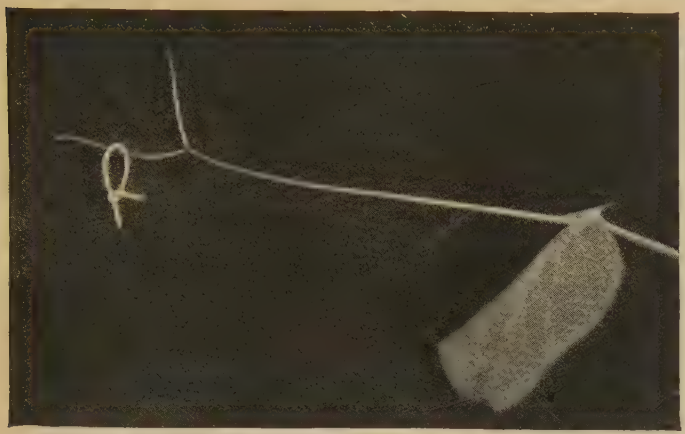


*Photo: S. Leonard Bastin.*

A tiny loop of thread was placed on a young Pea tendril—

pads which cling so firmly that it is often impossible to pull them from the brickwork.

In the case of the peas and vetches some of the terminal leaflets are modified into tendrils. All but two leaflets are developed in the common everlasting pea, whilst in the yellow vetchling (*Lathyrus aphaca*) every leaflet has become a tendril and the work of assimilation has been taken over by the stipules which are large and leaf-like. What may be called a halfway house between the fully developed tendril and the original plant organ is to be seen in the garden nasturtium where the leaf-stalks are sensitive and are able to curve round a support and thus secure a hold. Another common leaf climber is the clematis, which rambles even up high trees, fixing itself so firmly that the roughest winds can hardly dislodge the stems.

It is most fascinating to spend an hour or so studying the behaviour of the tendrils. The processes are always most active and sensitive when the temperature is fairly high and the air is moist. After a few hours' warm rain on any summer day, if we go down amongst the pea plants more will be learned about the tendril than can be gained from any amount of book knowledge. It is only in its young days that the tendril is mobile and sensitive. After it has secured a hold, or the search for a support has ended in failure, the process hardens and is no longer responsive to touch.

Although the movement of the tendril is not so rapid that it can be discerned with the eye, yet it is easy to prove that the changes of position are constant. Near to a young tendril place a stick at a distance of about half an inch. Come back again, say in ten minutes' time, and it will be found that the position of the tendril has altered. An old idea was that tendrils deliberately moved towards any likely support, but we must dismiss this pretty fancy. What actually happens is that the tendril revolves in an ellipse. Those of the pea take about an hour and a half to journey round the circuit, when the conditions are normal, and this continuous sweeping round will naturally increase the chance of the tendril coming into contact with a support sooner or later. These move-

*Photo: S. Leonard Bastin.*

—five minutes later, the tendril had felt even the slight weight of the thread.

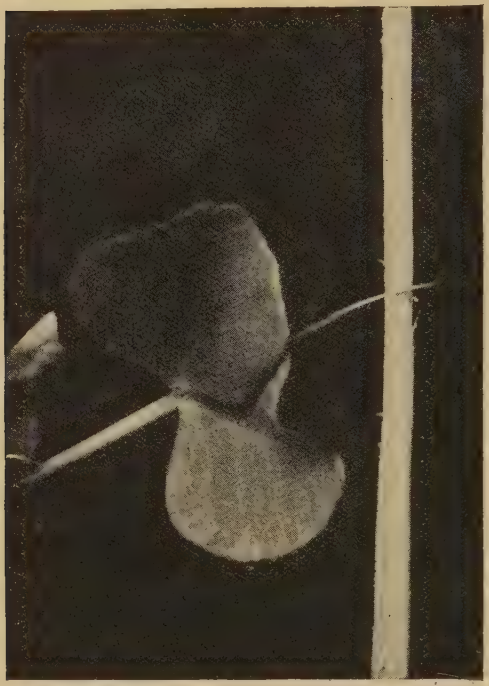


*Photo: S. Leonard Bastin.*

If a stick be placed at a distance of about half an inch from the Pea tendril—

ments are maintained even during the night, although they would be then slightly less vigorous than in the day-time.

It is easy to test the sensitiveness of the tendril. Choose one that is young and about an inch in length, and then touch it lightly with a twig on the concave surface near the tip. A few minutes afterwards it will be seen that it is definitely bending towards the direction from which the touch came. When the tendril comes up against an object this bending movement continues until it has made a complete circuit. Usually two or three sweeps round the support are made in order to make certain that the hold is secure. Finally the tendril contracts spirally, and in this way it becomes apparently shorter and obviously more elastic. Thus cables are formed which draw the plant nearer to the support and do not easily snap.

Darwin tells us that more than once he went out in a gale to watch a bryony growing on an exposed hedge with its tendrils attached to the surrounding bushes. He says, "as the thick and thin branches were tossed to and fro by the wind the tendrils, had they not been excessively elastic, would have been instantly torn off and the plant thrown prostrate. But as it was, the bryony safely rode out the gale like a ship with two anchors down, and with a long range of cable ahead to serve as a spring as she surges to the storm."

Striking experiments are possible to prove the amazing sensitiveness of the tendril in addition to the simple rubbing which was described in a previous paragraph. A tiny loop of thread was placed on a young pea tendril which, in a few minutes, began to curve round it, as shown in the photographs. When one thinks of the trifling weight of the piece of thread it is a matter of wonder that it could make any impression on the tendril at all. Darwin found that, in the case of the tendril of the passion flower, a piece of platinum wire *one-fiftieth of a grain* in weight caused the tendril to become hooked. It was noticed that the tip of the tendril began to move twenty-five seconds after contact, so responsive was it to the least irritation.

*Photo: S. Leonard Bastin.*

—even in ten minutes' time it will be found that the position of the tendril is altered.

# The World of Spiders

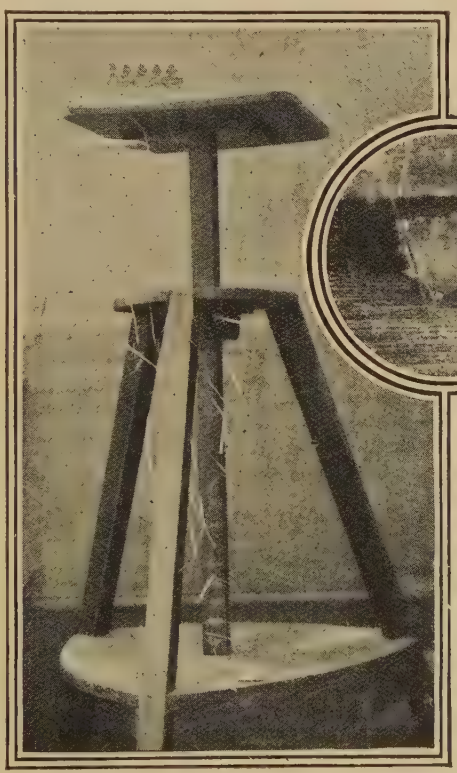
## 1.—BRIDGES AND NETS THAT THE SPIDER BUILDS

By JOHN J. WARD, F.E.S.

Illustrated with original photographs by the Author

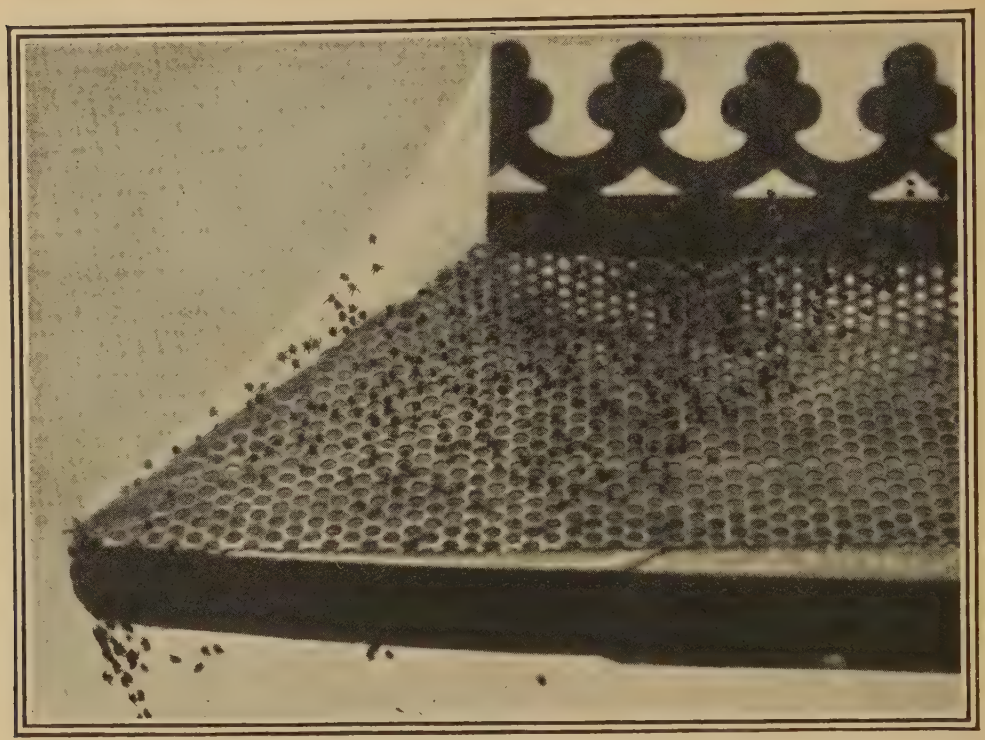
THE baby spider is one of the greatest wonders amongst living things. It is the merest speck of animate matter, scarcely visible to the eye, and yet is endowed with a simply astounding supply of energy. Furthermore, from the instant of its birth, it is a skilled engineer; untaught and untrained though it be, it will instinctively proceed to span a bridge a hundred thousand times its own length, or construct an efficient aeroplane to lift it into space, where it will steadily sail until conditions are suitable for it to alight on ground favourable for its development. There, with geometrical skill it designs a miniature snare perhaps no larger than a shilling piece, yet which embodies all the artifice and purpose which characterizes the large orb-like web of its mother; how the material is produced from its minute form is a puzzle that completely baffles understanding.

In the case of the orb-weavers (*Epeira*), of which the common garden spider is one of the largest species, the mother takes no further interest in the welfare of her numerous offspring after her egg-cocoon is formed; by that time her resources have become exhausted, and approaching winter speedily brings about her end. The silken cocoon with its 300 to 800 eggs, according to the species, withstands the cold of winter; and the following spring the baby spiders emerge.



The egg-cocoon (shown inset) is immediately beneath the white stone placed on the lower shelf of the stand. The young Spiders have emerged and travelled to the top of the stand, where they have reached a metal aquarium cover resting there. Thin strips of white paper are suspended in the delicate threads to show the course up which they have travelled.

In the accompanying photograph an egg-cocoon of one of the orb-weavers is shown. It is composed of yellowish-coloured silk, and was placed by the mother spider beneath the lowermost shelf of a wooden stand in my photographic studio; it is that of a species about half the size of the common garden spider, and one which is abundant in gardens.



A closer view of the aquarium cover, showing the young Spiders climbing up the silken lines they have spun.

The following May the spider family emerged, and the photograph on p. 349 shows their first efforts as engineers. The cocoon will be seen just beneath the lowest shelf of the stand, immediately under a piece of white stone placed on the shelf to mark the spot.

The eggs hatched out their young simultaneously, and the tiny ball of about four hundred baby spiders commenced to disentangle its collection of three thousand or so legs ; its more than two thousand spinnerets, of which each little spider has three pairs ; and its nearly a quarter of a million of silk-spinning tubes, each connected with a special gland in the body of the wee spider —for each of the two thousand or so spinnerets carries about one hundred of these tubes.

When this minute and complex machinery is unravelled, business commences immediately. Each tiny spider pushes away from its fellow by means of its eight legs, expanding the ball like a cloud of smoke. The motto for all is, thenceforth, " Tails up," for elevating the tail-end of its body each spider emits from its spinnerets a delicate silken thread, which readily floats on the lightest of air currents.

Of course, with so many threads afloat there was a hopeless tangle ; but that tangle may provide the bridge to the larger world outside. In the photograph on p. 349 the events described have taken place. Only when the air currents are favourable do the young spiders attempt to disperse ; that is usually on a calm, warm day ; a windy day is not at all suitable, for then the spider could not control its movements.

In my photographic studio the morning sun warmed the upper layers of air, and the sensitive baby spiders realized that then was the opportune time to release their silken streamers, which would readily ascend to the lighter layers of air ; indeed, they floated so successfully that they covered the top of the stand and became entangled with a metal aquarium cover that was resting there. To

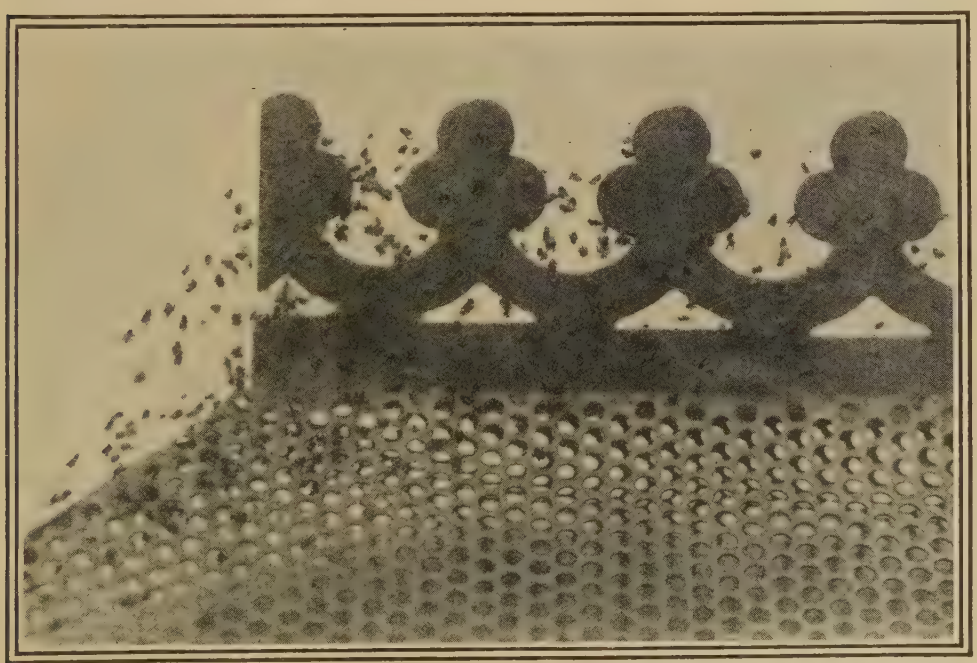
show the course of the hundreds of threads, too delicate to photograph, I have suspended amongst them some fine strips of white paper (*see photograph*).

So soon as the floating threads found anchorage the tiny spiders commenced their adventure into the great world, each one proceeding to travel up the ascending bridge of lines they had collectively built. What a marvellous bridge it was too! It ascended some five feet into the air; yet each of its engineers was a scarcely visible speck as it climbed to the top of the stand. Did human engineers ever throw up so proportionately large and wonderful a bridge? Such a bridge would have to be more than two miles in height, if they did. Then pause for a moment to think that there may be two thousand feet of silken cables employed in its structure—all obtained from the tiny bodies of the little engineers themselves.

That, however, was merely an initial effort; the real business commenced when they reached the aquarium cover, the highest extent of their bridge. On p. 350 they are shown coming up by various routes as the numerous threads guide them; and below a still closer view shows them at the attainment of the most elevated points of vantage, where they can turn upside down and project from their spinnerets silken streamers into space to become aeronauts, or at all events to get farther afield; for even baby spiders cannot live in a crowd such as that was.

Whence came their astonishing energy, for those little climbers ate nothing during their journey? The threads they had spun entangled no prey, that was not their function; they were merely "railway lines" on which they travelled. Perhaps it was that this journey had been a particularly smooth one; sometimes progress is slow and laboured on this journey to the open, and then their extraordinary store of energy derived from the egg may give out. There is a remedy, though, even for that emergency. The crowd of young spiders travel on for days together if needs be, but they gradually become fewer in numbers as they travel, while those which remain increase in size: the remedy is grim but effective, in a word it is—cannibalism. That perhaps explains why the mother spider deposits so large a batch of eggs.

The next move was to gain access to the surrounding trees, which not being available



A further enlarged view, showing the young Spiders attaining elevated points and turning upside down to project silken streamers from their spinnerets into space.

The first little snare built by the baby Spider is about the size of a shilling piece. How it learned its art is a mystery of instinct.

in my photographic studio, caused me to remove the wooden stand out of doors. In a surprisingly short space of time the young spiders had accomplished their purpose, and, an hour or two later, many of them had started business on their own account. The first effort of one of them is shown above, where it will be seen to have built a delicate and beautiful little snare about one inch in diameter, but entailing all the architectural skill of the larger web of the adult spider. It was a born geometrician, but how it learned its art was a mystery of instinct.

The little spider did not rest in the centre of its net, but made a silken-lined cell on the tip of the lower leaf to which its snare was attached, where it was always ready to answer its " telephone bell " ; for delicate threads, on which its feet rested, warned it of the slightest vibrations on its almost invisible net.

After having made one or two small captures of tiny winged flies, it was encouraged to a greater effort, and, tearing up its first web, it constructed one on a larger scale nearer the top of the branch, as shown below ; thus it was enabled to capture still larger " game."

When about a week old its ambitions were still more extended, and it proceeded to

After one or two small captures it was encouraged to make a greater effort.

destroy its second snare and to seek a new field of activity. Resting on the tip of the branch which bore its recent home, it emitted from its spinnerets a silken cable which reached into the atmosphere for more than six feet before it secured anchorage ; it was then pulled taut and tested, and, all being in

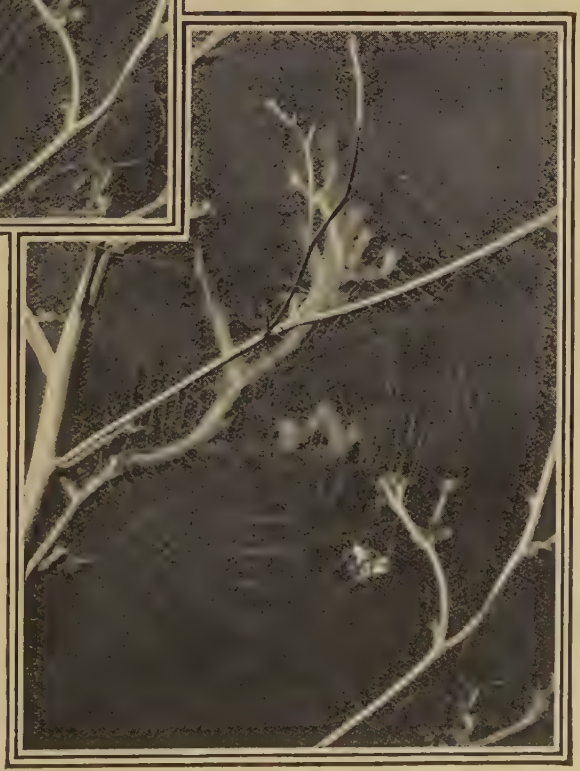
order, the spider moved gently along it to discover what new territory it had acquired.

The end of the cable having negotiated some substantial twigs, proved highly satisfactory for the growing spider. Without any delay it began work on a new net of between three and four inches in diameter. It is shown above with the spider resting in its centre, as it sometimes now preferred to do, particularly in the late afternoon in the warm rays of the setting sun; probably, then, its enemies, such as wasps, birds, etc., are less active, and it can afford to take the risk.

When about a week old it selected a fresh field of activity, and made a new snare between three and four inches in diameter.

Its new snare had not been laid many hours before a small-sized house-fly bungled head-long into it. This capture was larger than anything hitherto experienced by this hunter, and one whose strength produced tremendous vibrations on the net which had entangled it. For a moment the spider showed fear and was undecided how to act. Then that mysterious instinct, which was always ready to instruct it, promptly warned it that it must act, and quickly, otherwise there would be a badly damaged net, and a feast lost.

Instantly the spider gripped its snare and made a bold rush upon its victim. It was a tremendous struggle; the quarry was as large as the hunter, and possibly much stronger; many of the threads of the net were broken, but at the end of a minute the powerful fly was under complete control; not, indeed, by the strength of the spider, but by its skill in the



There it captured quite a large fly. It is seen in the right corner of its snare sucking the juices of its victim.

manipulation of a shower of silken threads thrown from its spinnerets, which entangled its victim's six struggling legs and its vibrating wings. The rest was easy, for now the spider could approach and apply its poison fangs; on p. 353 it is shown, after having applied its anæsthetic, grasping its victim and sucking its juices.

For a few days after this meal it rested, more or less indifferent to various small captures that its net accomplished, but it was not wasting any time, it was manufacturing in its glands larger stores of web-weaving materials, so that it could spread still bigger snares for its prey. By the middle of summer it was able to construct a net a foot or more across, in the midst of which it would sometimes rest in the characteristic head downwards attitude favoured by most spiders of its group; but, unlike them, it not infrequently assumed an attitude slightly out of the vertical, as shown on this page—apparently a peculiarity of its species.

When very warm weather came it preferred to spread nets on the ivy-covered wall, where they were almost invisible, unless seen in the early morning outlined with dewdrops (p. 355). As the sun gained power the moisture on the webs quickly evaporated, and, during the heat of the day, many unfortunate flies, which sought the coolness and shade of the ivy leaf as a resting-place, discovered those nets to their cost. Flies of the house-fly order, including bluebottles and greenbottles, are very much addicted to resting during the afternoon warmth on the leaves of the ivy; our little hunter occasionally requires big game of this kind as autumn approaches, for it has to accumulate in its body a big reserve of material for constructing a large silken egg-cocoon, filled with about four hundred eggs, even at the time when it has to build larger and yet larger snares to capture its prey.

As summer advanced the young Spider, which is a born geometrician, was able to construct wonderful snares measuring a foot or more in diameter.

There is another point. One wonders when seeing the spider draining the juices of a fly nearly double its own size, if it is that powerful victim that gives such vitality

**A SPIDER'S SNARE.**

The snares were almost invisible when spread over the ivy-covered wall, but the dew-drops of early morning would sometimes reveal them.

to the eggs which produce eventually the baby spiders whose prodigious feats we have witnessed.

In our gardens there are larger spider species than the one I have here described; but even their greater weight is no hindrance to them when bridging gulfs in space, or even when crossing a river from tree to tree, by means of their silken cables carried by the wind, as the accompanying photograph well illustrates. It is extremely interesting to see a large and heavy spider coming down a silken thread in this manner. Its weight would readily cause it to slide, but that might mean disaster; such an untoward incident is carefully avoided by the hind pair of legs pulling the thread in opposite directions, to cause a little kink in the line, which acts as an efficient brake.

A large Garden Spider bridging a gulf. Note how the "brake" is put on by the hind-feet pulling slightly in opposite directions so as to cause a little kink in the line.

Large-bodied garden spiders, such as that shown on this page, always represent the female of the species. Sometimes, in the late afternoon on an autumn day, a quite diminutive spider may be seen approaching one of these rotund ladies while she is resting in the middle of her large snare; not infrequently it is regarded as a young spider, but really it is Mr. Spider, who is enamoured with the charms of this lady of robust proportions.

His approach is never direct, but always by easy stages, with many sudden retreats. He is obviously a nervous lover; and he has very good cause to be. He makes scarcely any snare of his own; indeed, he requires but little to eat; his function in life is a brief one—merely to be the father of numerous offspring which he will never see. That is if all goes well; there are other possibilities.

After approaching and retreating for an hour or more, he, at last, nearly reaches the object of his adoration, when, suddenly, she moves. Instantly her lover has hurled himself into space, and is dangling on his *life-line* a yard below the snare. It is a "life-line" indeed, for instinctively he knows that he will be accepted; but what he does not know is whether it will be as her suitor or as her—supper.

There is no more economical animal on the face of the earth than the lady spider. She does not waste even her superfluous lovers, they are all eaten up—for the benefit of her race.

As I have previously written, the spider is a born engineer; its snare is constructed on the highest scientific principles; it exerts the maximum amount of strength, while the minimum amount of material is used for its construction. Some people will say that the spider is "a horrid thing"; it is, nevertheless, one of the most marvellous of living things—as I trust this brief account of its doings may help to show.

*Photo: E. St p, F.L.S.*

"Along the hedges sweet-scented hawthorn flowered like froth upon a wave."

## Pages for the Children

# IV.—How the Robber was Robbed!

MAY had arrived, and morning, noon and night the Fairy Spring was flitting from field to copse and copse to hedgerow, waking up the flowers here, there and everywhere. Along the hedges sweet-scented hawthorn flowered like froth upon a wave, and down in the meadow marsh-marigolds were giving place to blue forget-me-nots and the green lances of the iris.

The sun shone in a cloudless sky, and everywhere little creatures were coming out of their winter sleep. Under the orchard hedge a wee dormouse, who had spent the winter rolled up tight in his nest of leaves, began to uncurl himself and wondered sleepily if his food-store among the roots of the hazel was still intact. Up in the pine-tree above him a squirrel was doing likewise, sunning himself and thinking about breakfast.

Dormouse could not help feeling anxious about his hidden larder, for it had been a big task collecting all those nuts and seeds and grain last autumn, and he had eaten practically nothing all the winter. Only once or twice, on still, sunny days, had he uncurled himself and rambled over to his store-cupboard for a snack or two. But there—it was cold even then! Much better go back to sleep! He had had a good feed-up in autumn, and while asleep could very well go without. But now that spring was here, he began to feel really hungry, and decided that this very evening he would be up and about once more.

The children were all out of doors, and at the bottom of the orchard, deep among the buttercups and daisies, Popsi was lying, half-hidden by an old log.

She was watching a snail take his morning walk along a primrose leaf. But when she picked up a long grass and tickled him with it, he just curled up and disappeared inside his little striped house.

"Oh!" said Popsi, disappointed.

*Photo: S. Johnson.*

The Snail was enjoying his morning walk, but when he was poked he shut himself up in his little house.

"Naughty Mr. Snail! You *might* stay out and talk to me!"

"And so he would have, if you had not poked him," said a voice quite near. "You children must always be touching and meddling! Why could you not be content just to watch him without interfering?"

Popsi looked up, and there at the end of the log, sitting up and scolding, as squirrels always will, was a little red furry beast with his tail curled over his back.

"Oh!" she cried again, jumping up. But at her sudden movement Squitterfrill the squirrel darted off, scampered up a tree and went on scolding from a branch above.

"Oh dear, oh dear!" sighed Popsi. "The animals always run away as soon as I want to play with them. You cross old thing!" she called to Squitterfrill above, "I'll just go off and find Topsy and Boodles."

Away she went, and the squirrel watched her go, chuckling to himself.

And why do you think he was chuckling?

Why—because he had just caught a glimpse of a little bundle among the roots of a hazel bush that *might* be somebody's larder.

And though he could scold Popsi for interfering, he had no hesitation himself in poking into other people's affairs. And he wanted to get rid of her so that he might come down and investigate.

Sure enough! Peeping under the leaves between the roots he saw, rolled up in a nest, the carefully collected store of the dormouse!

"He! He! He!" laughed the squirrel. "Here's a find! I'll just have a jolly good breakfast, and then carry off the rest to my own cupboard in the hollow oak. Old Dormouse never gets up till dark, so I'm quite safe."

Meanwhile Popsi was hunting for the others. She went up the orchard and into the meadow where a family of little pigs were grazing, but no sign of them could she see.

"Well! I suppose I'll just have to play with the piggies!" said Popsi.

*Henry Irving*

**BUTTERCUPS AND DAISIES.**

At the bottom of the orchard the grass was long and full of flowers

The piggies were only too delighted. With a grunt and a jerk and a flap of the ears they scampered down the field, circled round, and waited for her in a little group. And as Popsi came up to them, there was Boodles, sliding down an old oak in the hedge.

"I say, Popsi!" he called. "Just look what I've found!"

And he held out a whole hatful of nuts and seeds and acorns.

"They were all in a cosy nest up in the hollow branch!" he explained, throwing them out on the grass, where they were at once gobbled up by the little black pigs.

"But Boodles!" said Topsy, who had arrived at the moment. "You ought not to have taken them! Perhaps they belong to somebody!"

"I expect they belong to that cross little squirrel," said Popsi, telling the others about him. "Let's watch, and see who comes."

So the children climbed up another tree near by, and hid themselves in the thick ivy.

Presently, who should come along but Squitterfrill, looking very bright-eyed and sly, both cheeks bulging with nuts he had stolen from the dormouse.

The children held their breath as they watched him creep along the branch and make straight for the hole where his own store had been hidden.

Then he leant over and peeped in!

Every single nut was gone!

And so the tables were turned and the greedy little robber was punished.

Photo: Frances Pitt.

"At the end of the log, sitting up scolding, as squirrels always will, was a little red furry beast with his tail curled over his back."

Photo: Albert H. Willford.

These young Blackbirds are fully fledged and ready to leave the nest in the apple-tree. When hatched they were blind, almost naked, and quite helpless—typical nest-dwelling youngsters.

# 16.—CHICKS AND NESTLINGS

By A. LANDSBOROUGH THOMSON, O.B.E., D.Sc.

ONLY a few weeks elapse between the day when a young bird emerges from the egg and the time when it attains practically full size and the first complete set of true feathers. Nevertheless this short period is one which is of great interest in many ways. In general, it is governed by a condition which makes it different from every other time of life, namely, by the absence of the power of flight. Now, for the great majority of birds, flight is the predominating factor in existence; it is, so to speak, their first line both of defence and of offence. The flightless age is accordingly a time of special danger and disadvantage, quite apart from such other disabilities of infancy as inexperience and small size. The period, together with the foregoing one of laying and incubation, is likewise a time of danger to the parents, which are naturally compelled to forgo some of their ordinary advantages as aerial animals. There are just a few exceptions to this rule of flightlessness during infancy, and these we shall presently notice.

The condition in which young birds are born into the world varies from one kind

to another, and at the outset we must recognize two broad divisions. These are called the *nidifugous* and *nidicolous* groups, "nest-quitting" and "nest-dwelling" young, and the distinction is perhaps conveyed to some extent by the words chosen as the title of this chapter, namely, "chicks" and "nestlings."

Among native British birds, the plovers, the ducks, and the game-birds may be mentioned as having "nest-quitting" chicks; but, indeed, one need not go beyond the farmyard to find good examples. In birds of this kind the young emerge from the egg open-eyed, alert and vigorous; they are plentifully clothed in soft fluffy down, and the legs are especially well developed. If there be a nest at all it is abandoned at once, within a few minutes it may be, and the youngsters are able to run, often with astonishing speed, and if they be of aquatic species they are also able to swim. In many cases, too, they can find their own food, and feed themselves without direct assistance. They are dependent on their parents merely for guidance and for protection, and perhaps for warmth during the night.

Growth is rapid, and the young birds soon begin to acquire true feathers in place of their natal down. As full size is attained the quills become strong enough for flight, and the young birds have passed the period of maximum danger; they are able to venture farther afield and to fend for themselves. Among the game-birds, however, there is what is known as "precocious flight": a temporary set of small quills appears when the birds are but half-grown, and so the youngsters are able to make short flights if occasion demands. This "precocious flight" is, nevertheless, not an unmixed blessing, for the broods tend to become scattered if alarmed, and some of

*Photo: Stanley Crook.*

A newly-hatched Lapwing chick affords a good example of a nidifugous or "nest-quitting" bird—open-eyed, down-clad, and active from the first day of its life. When only a few hours old these chicks can run with astonishing rapidity, find their own food, and hide themselves with the help of their "camouflage" colouring.

*Photo: Henry Willford.*

**CORMORANT WITH YOUNG.**

Young Cormorants are naked when hatched, but have an intermediate down plumage before acquiring true feathers. The youngsters shown in the nest here are half-grown.

their members are thus lost and so perish.

Any one of our common song-birds will serve as an example of the other division, in which the young are nest-dwelling. The same condition holds good in such other species as the swift, the green woodpecker, the heron and the cormorant. Here the young are hatched in a more or less naked condition and with eyes that cannot open, and in general they have a rather unpleasant appearance suggestive of prematurity. They are practically helpless and depend entirely on their parents for food as well as for warmth and protection. As a rule they remain in the nest until they are full-fledged and able to make their first attempts at flying.

Photo: Stanley Crook.

Young Owls are hatched with a full covering of down, but they remain in the nest until they can fly, and are fed by the parents. The illustration of a nestling Long-eared Owl shows a well-grown youngster which has begun to sit up and take notice.

In the swift, the woodpecker, the cuckoo and the kingfisher, the nestlings are at first entirely naked, and there is never any down plumage at all, the true feathers being the first to appear. Among the song-birds there is a scanty down plumage at birth, just a few tufts here and there growing from the still hidden tips of the true feathers which will shortly sprout. In the heron and the cormorant, however, the young are born naked, or nearly so, but afterwards acquire a full plumage of down which is worn for a time before the true feathers appear. A fourth subdivision includes the birds of prey and the owls; in these the young have a full covering of down when they are hatched, but are otherwise of the nest-dwelling type.

The gulls and the auks are rather intermediate in position between the two main groups. They are down-clad, open-eyed and alert from the first, but they are of nidicolous habit—often necessarily so from the situation of the nest (or bare ledge of rock)—and they are fed by their parents until they can fly, and even for some time afterwards.

Broadly speaking, the birds which have nest-quitting young are ground-nesters, and the birds which have nest-dwelling young are those which nest among trees or on cliffs or buildings. Where the nest is high above the ground it would often be impossible for the young to leave it before they could fly, and active habits during the nestling period would obviously be fraught with danger. Nor is it desirable that they should leave the nest and so cede the advantage of its inaccessible position; although, of course, the parents' task is made much heavier by the responsibility for providing the whole sustenance of the voracious young during the period of rapid growth. In the case of the ground-nesting birds, on the other

*Photo: F. T. Newman.*

Although Skylarks are ground-nesting birds they come of a natural order which is characteristically arboreal, and they have young of the nest-dwelling type.

*Photo: Stanley Crook.*

Curlew chicks have short straight beaks like those of many of their plover relatives. The long decurved beak typical of the Curlew develops as the bird grows.

hand, the nest—often a very slight affair at the best—offers no advantages, and the chicks are less likely to be discovered if they can hide separately. Most of them have "camouflaged" plumage and a habit of crouching motionless in the presence of danger, while the parents are often skilled in decoying intruders from the exact spot.

1.

2.

*Photos: Alfred Taylor.*

(1) Blind, naked and helpless, this four days old nestling Kingfisher is a good example of the type of young bird which is known as nidicolous or "nest-dwelling." (2) A brood of partly-grown young Kingfishers beginning to fledge. There is no down plumage before the true feathers, and when fully fledged in their first plumage the youngsters are brightly coloured like their parents.

These ground-nesting birds are in most cases also ground-feeding or aquatic birds, and the young can obtain their own food without flight and even without special tuition.

It is probable that the nest-quitting condition is the primitive one, for the nest-dwelling condition implies a rather highly evolved instinct of parental care as its necessary accompaniment. On this assumption we may suppose that the more highly specialized nest-dwelling condition has been evolved as an adaptation by those birds which have remained arboreal or have taken to nesting on cliffs, while no such development was necessary in the case of birds which had become ground-nesters.

There are, it must be added, some exceptions to the rule which has been stated. The skylark and the meadow-pipit, for instance, are ground-nesters, but nevertheless have nest-dwelling young. These birds, however, belong to the great order of song-birds which is predominantly arboreal, and it may well be that they have descended to the ground at a comparatively recent date (as evolution goes) and had by then already acquired the nest-dwelling adaptation which characterizes tree-nesting birds.

We have discussed at some length one of the most important aspects of the first few weeks of life, and we can now but briefly notice some of the other points of interest in the study of the chicks and nestlings of our British birds.

Young birds display a number of special adaptations to their peculiar circumstances, apart from the general ones which we have described. There is, for example, the so-called "egg-tooth," a small hard projection

YOUNG SONG-THRUSHES.

*From a Colour Transparency by Reginald F. Malby, F.R.H.S.*

on the tip of the beak which is used in breaking out of the egg and soon afterwards disappears. There is also the down plumage which has already been sufficiently mentioned. Among the nidicolous birds, too, there is often an interesting development of bright spots on the tongue and the inside of the mouth; these probably serve as a guide to the parent bringing food into a dark nest, for they are conspicuous when the youngsters stretch their heads upwards with mouths wide apart. Among the same kind of birds it is frequently to be found that the excreta of the young are encased in gelatinous capsules, so that they can be removed entire (or swallowed) by the parent birds and thus do not foul the nest.

There are other characteristics of young birds which are not specially adaptations to their condition, but are merely incidental thereto. It is, indeed, a commonplace in biology that a young animal of any kind tends to be less specialized than the adult, and to show features which hark back to the earlier history of the race, and thus provide us with interesting clues as to the lines which evolution has followed. A character which is present only in the young, and which is not an adaptation to the circumstances of infancy, may generally be regarded as a primitive character of the race which in the adult has become overlaid or transformed by some later development. In general, therefore, the young of allied species resemble each other more closely than they will when they have acquired the specializations of maturity.

*Photo: M. Best.*

Chicks of the Great Black-backed Gull are open-eyed and down-clad from the first, but remain in or about the nest and depend wholly on their parents for food.

A good illustration of this point is to be found in the curlew. The young of this species has a short straight bill such as is characteristic of the plover group as a whole, and it is only when the bird grows up that the bill lengthens and becomes downwardly curved. The same principle holds good in the case of the long straight bill of the snipe and the long up-curved bill of the godwit, whereas many of the other plovers retain the supposedly more primitive shape throughout their lives.

After young birds are practically full-grown and able to fly there may still be a further period of infancy during which they

are dependent on their parents for food. In the case of birds which live by hunting, or fishing especially, the art of obtaining food requires a greater or less amount of tuition. Sooner or later, however, the youngsters are finally able to fend for themselves ; among species which are not gregarious the offspring are then very frequently driven away by their parents, and this happens very quickly in the case of some of the small birds which rear two or more broods in a season.

When infancy is over there is still a juvenile or immature period during which the plumage is not infrequently different from that of the adult birds. (In some species, like the kingfisher for example, the bright plumage is nevertheless acquired at the first fledging). In the case of the smaller song-birds this time of immaturity lasts only during the first autumn and winter, the birds being in full plumage and ready to breed by the following spring. Some larger birds like the herring-gull and the gannet are believed to take four or five years to reach maturity.

It is a general rule among animals that the length of the immature period stands in proportional relationship to the total span of life, and it is accordingly probable that the longest-lived birds are those larger species which do not breed until they are several years old. We have, however, very little certain information about the ages which birds may attain in the wild state. The method of marking birds with inscribed metal rings as a means of studying their migrations has given us a few records of some interest in this respect. The present writer has thus recorded instances of a swift and a lapwing each living for seven years, a curlew for eight years, a song-thrush for nearly nine years and a wild duck for over ten years. But it is at the same time certain that the average length of a bird's life is short, and that very few chicks or nestlings are destined to pass many years in the world.

*Photo: Capt. H. Morrey Salmon.*

The young Coot is another example of a nest-quitting chick. They are no sooner hatched than they take to the water and swim with ease.

*Photo: Seton Gordon, F.Z.S.*

A unique photograph of a pair of Storm Petrels sitting outside their nesting burrow.

# 17.—THE SMALLEST BIRD OF OUR BRITISH SEAS—THE STORM PETREL

By SETON GORDON, F.Z.S., M.B.O.U.

THE storm petrel, by name, is familiar to most, yet very few have ever seen this little bird of the silent and storm-tossed ocean. Amongst mariners its appearance is counted unlucky, since it is said to foretell a time of tempestuous weather.

For a sea-bird it is unusually small, not exceeding a house martin in length. In its flight, too, it is not unlike that bird, and in appearance it is frail and fragile.

It is a bird of the night and of the twilight hours, fully as nocturnal as the owl or bat. But, like the owl, it may at times be seen abroad (upon the ocean) during the hours of daylight, provided the weather be dull and gloomy.

The storm petrel is the latest bird to nest in the British islands. During the winter and spring it remains out at sea beyond sight of land, and it is not until midsummer that it arrives at its sea-girt breeding haunts. Its nesting site is invariably—so far as my own experience goes—an island, and only the least accessible of uninhabited isles are chosen.

It is an interesting experience to arrive, during the sunny hours of a July day, at an island where a colony of storm petrels are nesting. The ground may be searched with care, yet no signs of the little birds are evident. But should one pitch a tent and pass a week on the isle, the experience is a fascinating one. July is the best time of the year for this purpose, for it is during the first week of that month—upon Scottish islands at all events—that the storm petrels commence to lay. The nesting site is subterranean. The nest may be placed at the end of a small burrow in the peaty soil, or far down in some cranny amongst the large

*Photo: Seton Gordon, F.Z.S.*

Amongst the large rounded stones which lie in confusion above high-tide mark, far down in some cranny, the nest of the Storm Petrel may be found

rounded stones which lie in confusion above high-tide mark, hurled there by the storms of many autumns and winters. The nest may consist of a few blades of dried grass, or the single egg—small, white, and glossy—may be laid upon the bare earth. But, as I have said, there is nothing during the sunny hours of the day to indicate that the small petrels are at home. Not until ten o'clock at night, when the sun is at length sinking toward the north-western horizon, is the silence of the boulder-strewn shore broken. From beneath the stones comes a curious low purring note. At first only one bird "sings," but soon others join in the purring. Yet no storm petrel is seen—dusk has not drawn her mantle sufficiently close for them to emerge from their twilight crannies. But when the sun has at length set and the island is bathed in the half-light of a midsummer night in high latitudes, the storm petrels emerge and fly bat-like backwards and forwards across their nesting ground. Should the night be windless they hawk the small moths that are abroad upon their island, but if a stiff breeze be blowing they must seek their food upon the sea.

It is during a wild night that they are most interesting to watch. Rough weather seems to fill them with a strange excitement and restlessness, and as they dash madly backward and forward through the mist-swept gloom they utter weird cries unlike those of any other bird. These calls of the storm petrel are positively uncanny, like the cries of wandering spirits, and are impossible to describe in words. When heard on a wild night, upon an island far from the mainland, with the roar of the surf and the melancholy howling of a great grey seal as

*Photo: Seton Gordon, F.Z.S.*

The Storm Petrel may lay its single egg—small, white, and glossy—upon the bare earth.

**CHICK OF THE STORM PETREL THREE DAYS OLD.**

Note the large opening to the nostril of the parent bird, and its conspicuous white rump.

an accompaniment, the haunting sounds are impressed for ever on the memory.

I have said that the storm petrels are silent during the sunny hours of a summer

*Photo: Seton Gordon, F.Z.S.*

Baby Storm Petrel—showing the thick coat of sooty down which enables it to withstand the cold.

day. But, on a calm and overcast afternoon, the little birds wake up at times, and may be heard purring beneath the stones, though I have never seen them venture abroad, at least over land, during the hours of daylight. This subterranean purring is at times difficult to locate, but in the vicinity of the nesting cranny there invariably hangs a curious musty smell, and by following up the scent the locality of the nest may be fixed. By exercising care it is possible to remove a sufficient mumber of stones to expose the storm petrel on her nest, and even to replace them without unduly exciting the small bird beneath. When exposed during the day-time in this manner she never takes wing but remains motionless, dazed, perhaps, by the sudden light in her nesting cranny.

Curiously enough the removal of the first stone does not quieten the petrel's purring—on the contrary, it has the effect sometimes of stimulating the bird into song, but as its covering of stones grows less, the bird once more becomes silent. For five long weeks the storm petrel broods her solitary egg. It is probable that both cock and hen share in this task, though nothing definitely is known as to this, for the sexes are precisely similar alike in plumage and appearance.

It has been stated in a well-known recent work on British birds that the storm petrel cannot walk. This may be true of the larger fulmar petrel, though dogmatic assertions are always dangerous, but it is certainly not true of the storm petrel. I have seen one of the latter birds walk out to the entrance to her burrow, and her walk was easy and graceful.

It is not until towards the end of August that the young storm petrel is hatched. For the first day or two of its career the youngster is brooded carefully by the parent bird, but later on it is left alone during the hours of daylight, both its parents remaining out at sea. The petrel chick is from the first clad in a coat of thick sooty down; upon the centre of its head during the first weeks of its life is a curious bald spot. For nine weeks at least the youngster remains in its nest. The earliest hatched birds are able to take their first flight about mid-October, but when visiting their nesting isle at that time I have seen chicks, still in the downy stage, which could not have been ready to leave the nesting site sooner than the first days of December. During the October days, cold, rainy and windy as they

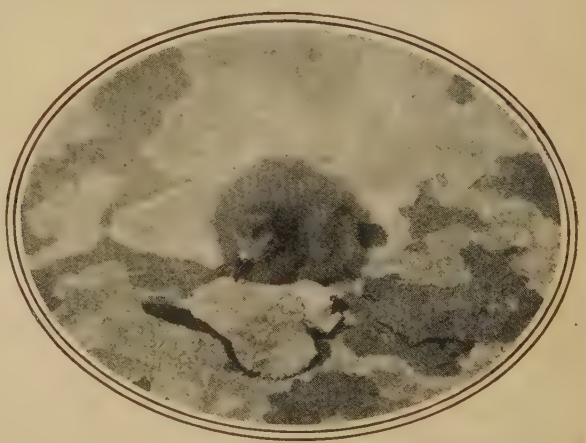


*Photo: Seton Gordon, F.Z.S.*

The baby Storm Petrel sat for his portrait on August 29th, when eighteen to twenty days old. Upon the centre of its head during the first weeks of its life is a curious bald spot.

often are in the west, these petrel chicks are left in the damp, cold hollows entirely alone throughout the day. To young chicks of our land-birds this Spartan up-bringing would certainly be fatal, but the storm petrel in its warm coat of nestling down seems impervious to the cold.

No one has ever seen a storm petrel take its first flight. How exciting an experience must this be for the youngster. Having passed the first two months of its life in a small dark burrow, or in some cranny down amongst the stones, one evening it clambers out into the open, spreads its graceful wings, and flies out to sea. Once abroad upon the ocean it no more returns to land until the call of summer and of family cares brings it in from the seas to the island where it first chipped its egg.

How is this inaugural flight made? Is the novice attended by its parents and guided out over the sea—stormy perhaps, and full of dread to the youngster? Even so the experience would be a terrifying one. But the reality is—if the storm petrel behaves as its relatives of over-seas in this matter—far more extraordinary. It would appear as though the young petrel is deserted by its parents when it is fully fledged. For some days it remains in its hollow awaiting the food which does not come, as of old, with the gathering dusk. At length hunger drives it forth, and its first flight is taken unaided and unwatched. If this procedure is indeed followed it differs little from that of the gannet, which betrays no interest in the first flight of its solitary offspring, but to us humans, with our superficial and limited knowledge of the great scheme of Nature, it appears callous in the extreme.

During the winter and spring the storm petrel is constantly at sea, often hundreds of miles from land. It seems almost incredible that so small and fragile a bird can survive the great storms which sweep the Atlantic during the winter, storms which in really bad weather may occur almost daily. When one remembers that liners of twenty thousand tons are compelled to stop and "heave to" to avoid being destroyed, it seems all the more remarkable that the little storm petrel should ride out such tempests.

*Photo: Seton Gordon, F.Z.S.*

Growing rapidly, the young Storm Petrel sits fearlessly upright. Patches of its baby down are seen still adhering to its feathering body.

How comes the storm (or stormy) petrel to receive its name? The answer is a curious one. It is from its habit of skimming the waves with dangling legs, its feet apparently touching the sea. It was thus held by mariners to walk the water as did St. Peter of old. Hence its name petrel, or "little Peter."

A peculiarity of this small bird is its habit, when alarmed or excited, of disgorging a small quantity of amber-coloured fluid. Its food consists mainly of the microscopic marine life which floats upon the waves.

*Photo: Seton Gordon, F.Z.S.*

The young Storm Petrel almost ready to fly. Note how closely the bird harmonizes with the rocks.

It is said to be partial to oil, and, as I have mentioned earlier, it hawks for moths during the time of its nesting.

It nests on remote seagirt isles throughout the British Islands, but its nesting haunts are, almost all of them, along the Atlantic seaboard. So far as is known, it does not nest upon the Farne Islands, or on May Island, and the only record of breeding on our eastern coasts is from the Bass Rock. On some of the outermost Hebridean isles it is replaced by an allied and somewhat larger form, the fork-tailed petrel. The storm petrel is found in the Orkneys and Shetlands and along the Norwegian coast. Farther north it appears to be absent, and I saw no traces of it upon the Spitsbergen archipelago.

The fork-tailed petrel was first found on St. Kilda, fifty miles north-west of the Hebrides. It was then supposed that this remote island was its only nesting place, but this has since been shown to be incorrect. The fork-tailed petrel is a somewhat earlier nester than the true storm petrel—it does not seem to lay in stony crannies, but at the end of a burrow in peaty soil, the birds excavating the hollow themselves. The egg is somewhat bigger than that of the storm petrel, and circling its larger end is a ring of pale red spots. Little is known of the incubation and habits of this petrel, for its nesting islands are, if possible, still less accessible than those of its little relative with which we have been dealing.

In the St. Kilda islands also, are found the nests and eggs of the fulmar petrel. This is far the largest of the petrels, being more like a gull in size and colouring. It is a British resident, though a wanderer amongst the islands. It is an almost wholly silent bird—making no sound, so it is said, even when its nest is being robbed. Like that of the other petrels, the egg is white, but it lacks the spots and markings that eggs of the others bear at the larger end.

*Photo: Peter Webster.*

The Storm Petrel, or "Little Peter," gets its name from its habit of skimming the waves, with dangling legs and feet apparently touching the sea. It was thus held by mariners to walk the water as did St. Peter of old.

*Photo: Peter Webster.*

The security of the Heron's nest is frequently attained by building on slender branches quite incapable of bearing the weight of a human intruder.

# 18.—THE HERON AND HIS WAYS

By FRANK BONNETT

GONE long since are the days when the heron was regarded by mankind with great esteem, though he was, and always will be, a notable bird. His size alone makes him conspicuous; and there are few British birds more noticeable or more easily recognized when on the wing. His popularity in olden days was due, however, not so much to his interesting personality, as to the sport he provided for followers of the ancient pastime of falconry. There is but little hawking nowadays, and the heron is no longer a favourite quarry, but time was when kings and noblemen came out to see the heron make his best endeavours to save himself from the falcon, and a heronry was one of the most coveted possessions of the great people in the land. Hence it was that the birds were strictly preserved long before the protection of any wild bird for its own sake was thought of. Indeed, it may be taken for granted that in spite of the persecution it received at the hands of the falconer, the heron once enjoyed a safer existence than it does to-day. The law which now gives it partial protection is not, one fears, nearly so effective as those dire penalties which in ancient days were visited upon those who dared disturb or slay a bird of such distinguished patronage.

If only because of this once proud position and his long association with the history of these islands, the heron deserves a better fate than to be shot at sight or—worse still—to be meanly trapped, as he so often is in these degenerate times. Apart from this, he is also a bird of such interest that he still deserves to be regarded with respect. The crime urged against him, of course, is that he is a fish-eater, which fact causes him to be included in the list of "vermin" from the angler's point of view. All are not so

hard on him as this, however, for many anglers recognize that the heron does not live by fish alone, while others would not grudge him a share in the sport that he probably enjoys as much as they themselves.

*Photo: Seton Gordon, F.Z.S.*

Herons are early nesting birds, and though not, properly speaking, of gregarious habit, they are to be found in companies of considerable size at the nesting season.

It is the water-keeper who seldom has a good word to say for the heron, and finds in him, perhaps, a useful scapegoat when his master's fish are not so plentiful as they might be. If there be one or two herons about, they will certainly get the blame when things go wrong, for they cannot be considered desirable visitors to water where game fish are strictly preserved. In such cases, unless some means are taken to keep them at bay, they may at times do harm if other opportunities of obtaining food are few. But in any district where so-called " coarse " fish are plentiful, the birds are not likely to do much harm to trout, and since most British waters are overstocked with the commoner fish, the heron is surely welcome to as many of these as he likes. It must also be borne in mind that the weakest fish, including those actually diseased, fall the readiest prey to the heron. These are better out of the way from every point of view, so that in that direction, at least, he can prove an ally of the angler in the latter's attempt to improve his waters and his sport.

Apart from a diet of fish proper, herons subsist very largely on the miscellaneous fare that abounds in marshy places. Frogs, newts, water-voles, beetles, fresh-water snails and mussels, together with a variety of water-loving insects and their larvæ—all these are acceptable food ; while wherever a sewage farm exists, the herons will spend much of their time in collecting tit-bits from the accumulated garbage, in which also are to be found a multitude of maggots and such small fry of the locality.

Though not, properly speaking, of the gregarious order, herons are to be found in companies of considerable size during the nesting season, and on the approach of spring they begin to congregate in their accustomed quarters. There is no prettier sight in these islands than the heronry at this time. Herons are early-nesting birds, and tradition has it that they return to their nesting haunts each season with the coming of the February moon. As with rooks, a good deal

EXPECTATION

A Heron in its fishing ground

*Photograph by Alfred Taylor*

A THICKLY POPULATED HERONRY

The Heron prefers to nest in the topmost branches of the tallest available trees

*Photograph by P. Webster*

HERON NESTLINGS A WEEK OLD

A YOUNG HERON

The rapid growth of the nestlings is doubtless due to the fact that they are fed practically day and night

*Photographs by Alfred Taylor*

YOUNG HERONS INDUCING THE PARENT BIRD TO DISGORGE FOOD

*Photograph by Captain C. W. R. Knight*

*Photo: Stanley Crook.*

**THE HERON.**

In the days of falconry the Heron enjoyed protection as a sporting bird, but he is no longer a favourite quarry. Indeed, as a fish-eater he is regarded as "vermin" from the angler's point of view.

depends upon the state of the weather at this period, but if it be mild it is quite certain that some time during the second month of the year signs of activity will be noticeable among the herons' nesting-trees, and not long after the whole colony is in active being. The first few days are spent, apparently, in inspecting the remains of last year's domiciles, the condition of which will depend upon the amount of damage wrought by the winter's storms. Some may be past repair and will be abandoned as useless; others will be considered worthy of renovation; and these matters, together with the problem of selecting new sites for the additional nests that may be required, will lead to much discussion and possibly no small amount of squabbling between rival claimants for some particular position. In this way a good deal of time is wasted, but presently every point will be settled and building and repairing embarked upon without further delay.

In a very short time some nests will be in order and the eggs laid, but in others the progress is comparatively slow, so that when in the early days of April the voices of the first newly-hatched broods are heard, there may still be nests in which incubation has hardly begun. In a heronry of considerable size the nesting season is likely to be spread over a long period, and summer may be well advanced before every nursery is emptied of its noisy brood.

*Photo: Alfred Taylor.*

Young Herons, a week old, squabbling in the nest, probably over a question of food supplies. The time never seems to come when every hungry mouth in the heronry is satisfied.

In a normal year, however, there will be enough young birds out of the nest before

the leaf is fully out for anyone to obtain a fair view of the colony. Naturally enough, the herons are apt to resent intrusion at this season, but if due precautions are taken, and the observer approaches cautiously, remaining perfectly still when once in position, they will soon recover confidence and carry on their usual occupation. A pair of glasses is indispensable, for the herons prefer to build in the topmost branches, if not always in the tallest trees. It is only when no tall trees are available, and water or some other effective barrier renders them reasonably safe, that they will build close to the ground.

In most cases herons, like rooks, select for their nests trees which are not easily climbed, and add to their security by building on slender branches quite incapable of bearing the weight of a human intruder. They may, however, have another reason for this expedient. The supple bough that sways with the wind is safer than one which, offering resistance to the gale, may be snapped off at a critical period. Doubtless the birds realize this, though sometimes, through careless construction or ill-chosen position, a nest may be blown bodily from its moorings in an exceptionally strong wind.

*Photo: Alfred Taylor.*

A young Heron, or "Brancher," in his first feathers will perch in a contemplative attitude a little way from the nest, as though enjoying the breeze which ruffles his coat.

The comings and goings of the old birds are as interesting to watch as the young ones in the heronry itself. No parents work harder than they, and the amount of food that their offspring consume must be prodigious. The rapid growth of the young heron is doubtless due to the fact that it is fed practically day and night, and it is only because they are able to carry on each journey a cropful of food to disgorge at the nest that the parents are not worked to death. The time never seems to come when every hungry mouth in the heronry is satisfied, for no sooner is one brood silenced by a hearty meal than another begins to shout for more. During those brief periods of time when one pair or another of the old birds is permitted to rest, they make a fine picture, perching, sentry-like, on some topmost bough, their tall, upright bodies swaying gracefully to and fro, and their nuptial plumes shining resplendent in the sunshine. Amid such surroundings, shown to advantage against a background of fresh green leaves, the heron loses that disproportionate legginess that is so evident when

he stands upon the bare ground, but which is necessary, of course, to his mode of life. He is more graceful when standing knee-deep in the water, one leg characteristically drawn up against his breast; but never is he seen to better advantage than when, still dressed in his wedding garments, he stands perched among the foliage of early summer in the heronry.

Many of the existing heronries in this country may be traced back to mediæval times, and some of them, doubtless, are much older, though the colony does not always occupy its original position. For this it is easy to trace the cause. As the years go by the trees in which the herons may have built for centuries gradually begin to show signs of decay, and the birds taking warning from the dying branches, will move off to safer quarters near at hand. Such migrations are usually quite gradual and may be spread over many years, but the felling of trees near by the heronry or the uprooting by gales of any trees used for nesting is apt to cause a more or less sudden stampede. A Sussex heronry of some two hundred nests, said to have been very much larger in former years, was thus suddenly broken up some years ago, much to the regret of the owner, who had not realized that the birds might take fright at the cutting of timber which did not actually form part of the settlement. In this case the birds only went a few hundred yards, but their move took them on to another property and into a different parish.

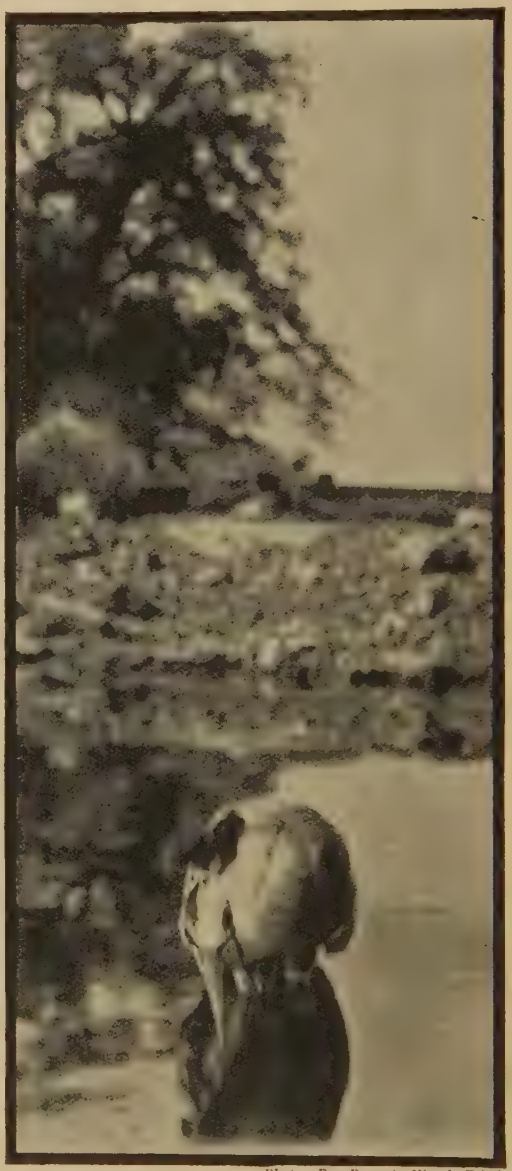


*Photo: Dr. Francis Ward, F.Z.S.*

The Heron as a fisher naturally finds his easiest prey in the weakest fish. In ridding the water of such specimens he deserves, at least, the respect of anglers.

In the absence of any special cause of disturbance, herons are very loath to leave their ancestral home, and in spite of receiving no special protection or encouragement, will cling to the same spot for generations. They will put up with mild interference on occasion, provided it be of a temporary character only. There is in the south of England, for example, a very ancient heronry in which rooks also nest, sometimes in the same trees as the herons, and here every spring the young rooks are shot in accustomed fashion. During the shooting, the herons, like the rooks, display great alarm, but as soon as it is over settle down again as if nothing had happened. As a rule the heron does not display the same confidence in man as is the case with the rook. The latter bird appears actually to enjoy the company of mankind, if one may judge by its

preference for nesting close to human habitations. Herons usually prefer more secluded surroundings, though the existence of a rookery has at times tempted them to set up house in some more public place. Rooks and herons appear to fraternize well together, though cases of temporary disagreement have been noted, and there is at least one recorded instance of a battle royal in which blood was shed.

A friend of the writer's, whose veracity is beyond all question, once witnessed an encounter between a heron and a peewit. The latter, whose nest must have been hard by, opened the attack on the much larger and stronger bird. The battle, which took place in the air and was fierce while it lasted, was ended by a savage thrust from the heron's beak stabbing the peewit so severely in the breast that it fell lifeless to the ground. Such an unlooked-for happening as this may have been due to mere chance, for it is doubtful whether the heron intended to do anything more than drive away its tormenter. Herons are often " mobbed " by other birds, not infrequently by rooks, in which instances the latter may be taken to be strangers. On these occasions, whether it be harried by a single bird or by many, the heron seems to endure persecution without much resentment, its chief desire being, apparently, to get away. It is by no means a bird of pugnacious or interfering instincts, and it is, therefore, all the more difficult to understand why it should be subjected to such frequent annoyance. Perhaps it is just a form of teasing which the weak are sometimes so fond of inflicting on the strong—especially when they think it can be done with impunity. When cornered, however, the heron defends itself to some purpose with its beak. If shot at and wounded, or caught in a trap, it will attack anyone who comes within reach, and at such times no dog that has any respect for his person will approach it.

At the present day Great Britain can still boast of some hundreds of heronries, most of which, however, are only small settlements consisting of anything up to five-and-twenty nests apiece. Ireland also has a considerable number, but the tendency to-day is for these colonies to decrease. The birds wander so far afield after the nesting season that they run many risks of being destroyed.

*Photo: Dr. Francis Ward, F.Z.S.*

In this illustration the Heron, disturbed while fishing, is seen leaving the water. His flight at such a time is always rapid.

*Photo: Howard Bentham.*

The Skylark has inspired more poets, perhaps, than any other British bird. It may be seen amid tufts of grass, ling, or heath, and towards the end of the breeding season its notes are frequently uttered from the ground.

# 19.—PLEASURE IN OUTDOOR NATURE: STUDY OF BIRDS.*—Part II

By THE RIGHT HON. THE VISCOUNT GREY OF FALLODON, K.G.

A FURTHER aspect of birds, perhaps the most attractive of all, is the gift that some of them have of song. If people wish to appreciate our common birds they must learn their songs. There is more pleasure to those who know them in the songs of birds than in almost any other aspect of bird life. It takes some trouble to learn them, but it is almost essential to pleasure in bird life to have a reasonably good knowledge of them. The best time to get this knowledge is from the middle of April to the middle of May, when all the birds are in full song, when the summer birds are here or on the way, and the leaves are not fully open on the trees, so that you get the best view of the birds. The songs of our common birds are no doubt known to many of you, and I would only say one or two things about them.

First of all, if you are fond of songs of birds make a point of not letting any month go by without hearing the robin and the wren sing, because these two birds can be heard throughout the year. If there is a very cold and severe month you may not be able to hear them, but in an average year you can hear them sing in every month. The wren's song is remarkable for its exceeding loudness compared with the size of the bird. You will not have much difficulty in getting close to it when it is singing, and if you consider the smallness of its body, the loudness of its song, the vehemence of it, and the animation of the body—well, really, I have sometimes been afraid that the little body would burst and be shattered by the vehemence of its singing.

There are other birds that sing only for a few months. The blackbird is one of our best singers, but you will not, as a rule, hear it before February or after the month of June. I have known of people hearing blackbirds in January, but when I have been able to investigate the matter, I have found a missel-thrush to be the songster. In the early part of the year the hearing of the first blackbird's song is a thing specially to look forward to, precisely because you have not heard it for so long. This is an instance where anticipation increases pleasure. And then, as the season goes on, there come the summer birds which have spent the winter in North Africa or even farther south. There is not only pleasure in hearing their song for the first time each spring, but there is something romantic in thinking of the immenseness of the journey they

* A lecture delivered to the Nature Study Union. Reprinted by courtesy of the Union. (Hon. Sec., Henry E. Turner, 1, Grosvenor Park, Camberwell, S.E.)

may have accomplished since you heard them the year before. A swallow, ringed in Great Britain in the summer, has been found as far south as Natal, thousands of miles away; yet, if all went well, that swallow would have returned not only to the country, but to the particular spot where it had been reared.

And so with other birds. The anticipation in the spring of the coming of these birds from the places where they have spent the winter is a thing to which one looks forward with the greatest interest. You will probably hear the first blackcap, the first willow wren, and the first wood-warbler, and so forth, each year in much the same place as you heard it before. Thus, when one gets fond of these birds and acquires the habit of listening for them in the same place at the same time every spring, the satisfaction of having your anticipation realized, of hearing the same song in the same place for perhaps thirty years, and knowing that some bird has come back to the same spot, is a satisfaction which gives us peculiar pleasure.

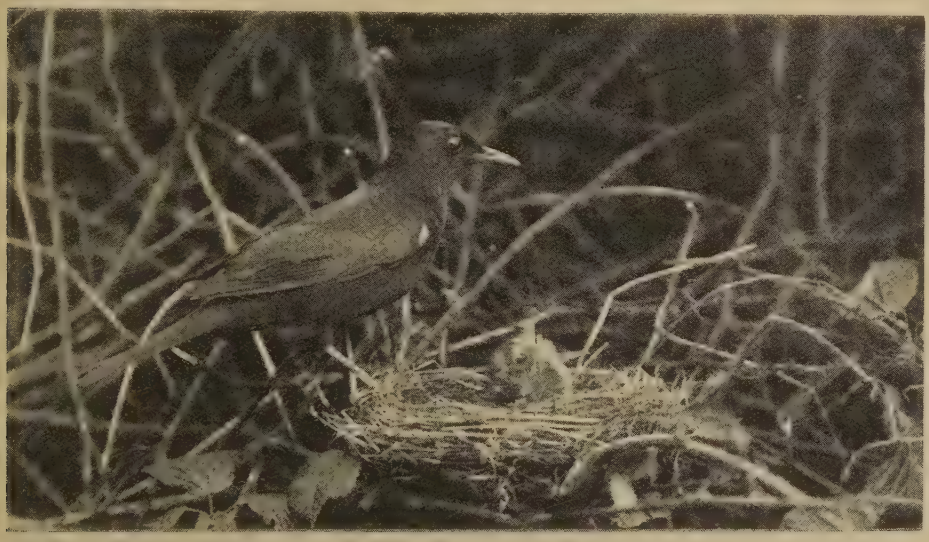


*Photo: L. J. Langford.*

In the nesting season the male Blackbird may be seen to advantage on guard over his brood. One of the best of British songsters, he is not heard, as a rule, before February or after the month of June.

It is not only of the birds which come to us in the summer that I would say something. There is also the other migration to look forward to, the birds which come to us from farther north or farther east to spend the winter in Great Britain. One familiar instance is the woodcock. Many woodcocks breed here, and presumably never leave these islands. But the great majority of the woodcocks we have in the autumn and winter come from farther north or farther east. They cross the North Sea —a formidable width for small birds to cross. We are told by those who have studied these things that there was a time when the North Sea was all land, and perhaps that is the reason why some birds undertake this tremendous journey across it. If the species came that way when the North Sea did not exist, I suppose they may have kept up the habit when the North Sea was gradually formed, though I am not sure whether birds existed at the time when there was no North Sea.

I was once lying on the sand-hills by the shore in Northumberland on a fine, bright, still day about the end of November. I was lying on my back looking up at the sky and I saw a woodcock arrive, evidently from a great height, with great velocity behind its descent. It slanted down over me at tremendous speed. It descended with wings not quite fully extended and rigid; it seemed

*Photo: B. Hanley.*

A notable winter visitor is the Woodcock. Although many of these birds breed in the British Isles, and presumably never leave our shores, the majority come from the North and East.

doubt many perish on the way.

However, it is not very surprising that the woodcock crosses the North Sea, when the smallest bird we have, the golden-crested wren, crosses it in numbers every autumn. The golden-crested wren is very common in Great Britain wherever there is woodland, especially fir trees. If you get to know their song you can realize how common they are. Many of them breed in this country and probably never leave it. They are not very shy; you can get close to them, and the only difficulty in watching them is that they are so very

to come with precipitated and great speed from very high up. I saw that it lit in the rough grass about seventy yards behind me. I wished to know if it was tired after its long flight, so I went to see how it was. It rose several yards in front of me and flew away over the fields inland with no sign of being tired, and from that I judged that in the ordinary way, with fine weather, birds can cross the North Sea quite easily without being exhausted or tired. When they meet with bad weather they arrive very exhausted, and no

*Photo: B. Hanley.*

The Jack-snipe, another migrant to British shores, indulges in a joy flight. He flies in a wide circuit, making a short descent from time to time in the air, and achieves with the vibration of his tail feathers a noise like the bleating of a goat.

*Photo: Henry Wilford.*

**NEST OF THE WILLOW WREN.**

Each year, in much the same place as before, the Willow Wren will nest amongst coarse grass and weeds, and frequently amongst open bushes on the banks of tree-fringed streams.

Photo: Stanley Crook.

The Widgeon sometimes breeds in Scotland, but the greater number go much farther north, and return in flocks during autumn and winter.

restless. Now the next time you have the opportunity of getting close to one, just consider the fact that, though that particular bird may never have crossed the North Sea, thousands and thousands of golden-crested wrens, exactly like it, as small and apparently as weak, do cross it every year. One observer in Heligoland years ago, in 1882, saw such a mass of golden-crested wrens arriving over the sea that he compared them to a snowstorm, every bird representing a flake.

One more instance I would give you as to migration to show how attractive it may be and to show you also how much can be done in taming birds. In 1921, in my garden, there were reared two or three broods of widgeon, which, as you know, is a British duck. There are some that breed in Scotland, but the bulk of them go much farther north to breed and come to us in flocks in autumn and winter. Three of these birds reared in the garden grew so tame that they would take food out of my hand, not snatching it, but continuing to feed with the bill in the palm of my hand with complete confidence, though in a wild state they are very shy birds. In the spring of 1922 they went away—two drakes and one duck. Presumably they joined flocks of wild widgeon going north. They may not have gone far, or they may have gone far north; anyhow, they were away for about seven months. In November of that year the female bird returned, and came up to me and began feeding in exactly the same way out of my hand as she had done before she went away. About three weeks afterwards one of the male birds came back and did exactly the same. It is exceedingly attractive if you can make birds so tame that although they may be away amongst wild birds six or seven months, they yet come back to the same place, and are as tame as they were before.

Birds have, to a greater degree, I think, than any other animate creature, except man, the power to express joy. I will give one or two instances. The flight and song of the lark are familiar to you; it is a real and evident joy flight. The note of the curlew in spring is a long vibrating whistle, which is full of joy and very wonderful in expression; this is uttered mainly in the air, but sometimes partly on the ground. The snipe, too, has a joy flight; he flies in a wide circuit, and

making a short descent from time to time in the air, achieves with the vibration of his tail feathers a noise like the bleating of a goat, which apparently gives him great satisfaction. He will fly round and round for some time continually making that noise, and you cannot watch it without seeing that the flight is an expression of joy.

You have also the family life of birds to consider. Nearly all our British birds are monogamous. There are some exceptions. The blackcock—black game—which are indigenous British birds, are polygamous. I do not count the pheasant, because the pheasant is not an indigenous bird. He was imported from the East and brought his Eastern customs with him. But most of our birds—the vast majority—are monogamous, and the larger birds, perhaps the smaller ones too, pair for life. I warned you before that when you studied the habits of birds you always found the cuckoo at the discreditable end, and the cuckoo is said to be polyandrous. Though, with very few exceptions, our birds are all monogamous, in family life they differ. The long-tailed tit's family remain together all through the autumn and winter, sometimes joined by another family. Rooks, of course, live in a community ; I think it is not so much family life as life of a community in the case of adult rooks, but with long-tailed tits and partridges it is a real family life which is continued after the young birds have grown up until pairing time in the next year. Anybody who has had a tame covey of partridges knows how attractive their family life is. The difficulty I have found is that they have never stayed with me after October, but have fallen in with wild birds and left the garden, but a tame covey of partridges is one of the most attractive things I know. That is a high form of family life.

Now consider the robin. He has as little family life as he can. Of course, a pair of robins rear their brood each year ;

*Photo : Henry Willford.*

On its nest of fine grass, lichens, green moss, hair and other materials neatly felted into a compact and cosy structure, sits the Golden-crested Wren, the smallest British bird. It is very common, especially in fir woods.

they may have a second brood, but when the young are able to look after themselves the old birds make the young ones separate from them. And they are not content with that; the male and female will not spend the autumn and winter together, but each robin has its own territory in which it remains separate and alone through the autumn and winter. If you work in the woods or in the garden you will notice that you are often attended by a robin, but only one at a time, and if another turns up there is a fight between the two. The law of robins apparently is that, except in the actual nesting period, each robin must have one territory, and if another robin comes he or she is breaking the law of robins. This law is as unalterable as that of the Medes and Persians; it is probably much older, and it has certainly lasted much longer. I know of a robin in the nesting season that was so anxious to get food for its young that it acquired a habit of coming on a human hand to get food. It reared two broods this year, and for a time the young were in the same place with it. That robin remains there now, and will come on the hand and sit there and feed, he is so confident. But he never follows you from his own particular territory; if you want to give him food you must go to his territory. If you go to another part of the garden, some fifty yards away, another obin will come and stand close by, and if you put your hand on the ground he or she (whichever it is) will take something out of your hand. Its habits are quite different from those of the other robin. You never see the two together. Then again I pass to the discreditable end of the scale and find the cuckoo, which has no family life at all. It is sometimes said that cuckoos exercise a certain kind of superintendence over their young that are reared by other birds; but it is doubtful.

I have taken these instances of birds from common things, because I am trying to show you the sort of pleasure which anybody that has an interest in birds may find. All the things I have been telling (except the instance of the widgeon, which I admit requires an enclosure with a pond, where things can be kept quiet) are what anybody who lives in the country may notice and enjoy for themselves; and they cost nothing. You want really nothing except the power of walking about, good eyesight, and good hearing. Of course, a push-bicycle is very useful, far better than a motor bicycle or a motor-car, which ties you to the roads and makes speed the main object. A push-bicycle is a much more subservient thing. It is silent, and it can be wheeled across places where no motor can be taken. A pair of good field-glasses are also useful.

*Photo: L. J. Langford.*

The male Robin is a pusillanimous sort of creature. Selfishly he clings to his own territory, and if another turns up, there is sure to be a fight. Except in the nesting period, an intruder is always dealt with as a culprit breaking the law of robins.

Of course, outdoor nature includes many other things about which I am not qualified to speak. A friend told me that when bicycling near my home with an ordinary hedge on either side of the road, and a wood on part of one side of it, in one half-mile, without getting off his bicycle, he counted forty-six different kinds of wild flowers. Think what that half-mile was, from the point of view of interest to my friend, and what pleasure people may have who know anything about flowers.

The whole world of flowers and trees, of

*Photo: Stanley Crook.*

**A COLONY OF ROOKS.**

With the Rooks it is not so much a case of family ties as one of communal life.

course, can be treated from the same point of view as that of birds. Then there is the whole world of insects—a very gruesome world by all accounts in some respects, but extraordinarily interesting. There is the weather, which may be of the greatest interest. I take great interest in the weather in the country. It is always some sort of a day in the country. The first thing I want to know when I wake up is what sort of a day it is.

Then the seasons, and everything which the seasons bring with them. There is a book, a very remarkable one, written in German more than sixty years ago, I think, but translated into English, called "On the Heights." In it there is this sentence—a peasant woman and her husband happily married, living on their own plot of land, and one day the peasant woman is looking out of the window at the fruit trees in the orchard and she says meditatively: "These are the trees that blossomed and bore fruit, and then the snow fell upon them, and then it was spring again." In that one sentence there is the feeling of outdoor home. You want to be in the same place, seeing the trees and seeing the seasons passing over the same trees, seeing the first tender green of the leaf come out in April or May, and then seeing the beautiful colour of it in the autumn.

I would quote to you two stanzas of Wordsworth which seem to me to have in them the feeling that I have been trying to express of the beauty of nature, of something which may be a joy to everyone. They are these:

They dance not for me,
Yet mine is their glee!
Thus pleasure is spread through the earth
In stray gifts to be claimed by whoever shall find,
And a rich loving kindness, redundantly kind,
Moves all nature to gladness and mirth.

The showers of the spring
Rouse the birds, and they sing;
If the wind do but stir for his proper delight,
Each leaf, that and this, his neighbours will kiss;
Each wave, one and t'other, speeds after his brother;
They are happy, for that is their right!

That is the "joy in widest commonalty spread."

*Photo: Stanley Crook.*

An April visitor, much loved for his free and powerful song, is the Blackcap. He generally returns to his haunts of the previous year.

# Wild Flowers and Their Ways

## 8.—PLANT ROSETTES

By EDWARD STEP, F.L.S.

With photographs by the Author

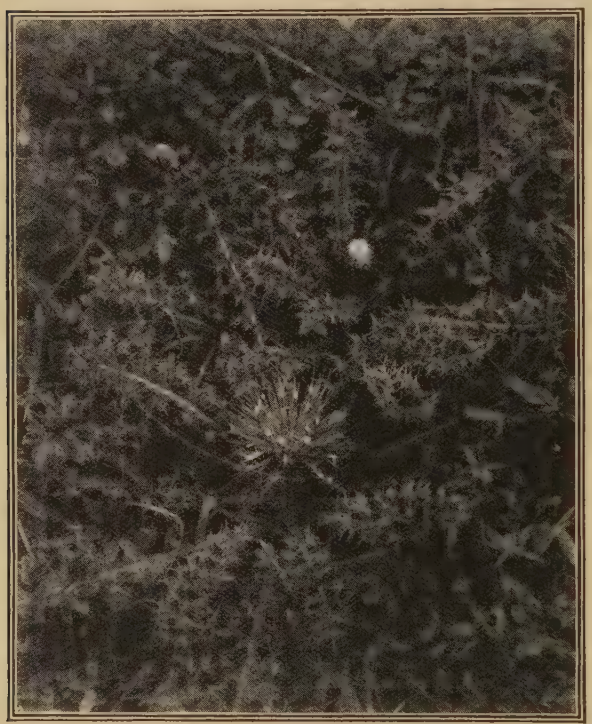
THERE are those who suppose that when the wild plants are not in flower there is little to interest the amateur botanist in the countryside. This is a great mistake, for the genuine flower-lover has the æsthetic sense well developed, and can appreciate beauty of form as well as beauty of colour. Without the flowers to arrest his attention, he is able to enjoy the pure ornamental forms adopted by leaves, and to appreciate the utility that goes with grace and symmetry.

One out of the many lines along which the study of plant beauty may be followed is to gaze downward in the open spaces of woods, in the fields and along the hedgerows, from autumn to spring, and look out for the biennial and perennial herbs. During their first year such plants give no sign of any preparation for flowering, although in reality they are making strenuous efforts to that end. All the plant's energies are bent to the accumulation of a sufficient reserve of material from which, later, it can fashion a tall-flowering stem and the exquisite tissues and pigments that constitute the flower. In many cases it will be found that it is forming a thick underground rootstock filled with starchy matter, as in—to take exaggerated examples—the cultivated parsnip and swede. Above ground there may be a rosette of leaves, the workshop of the plant, in which the starch is manufactured and from which it is being poured constantly into the reservoir below.

Amongst the reasons to be inferred for the formation of plant rosettes, such as that of the Hoary Plantain, is the dominant one of self-preservation from cattle on grazing land. The plantains usually escape because they sit too closely to the soil.

These rosettes are often forms of great beauty, and it is surprising that no mention of them is to be found in the standard "floras." At the most there may be a description of the "radical leaves" where those of the rosette differ from the "cauline" or stem leaves. This is the more surprising when one considers not only the important part played by these rosettes in the life history of the plant, but—what is more important from the point of view of the compilers of "floras"—that they are distinct helps to the identification of plants that have not reached the flowering stage. But in the past the floras have been compiled mainly from dead material in herbaria, and until lately these have not included specimens of the plants showing development from the seedling stage.

A little light is thrown upon the purpose of the rosette when we discover that it is not formed fully in the case of annuals—that is, plants that arise from the seed and in the course of a few months have reached their full stature, flowered, ripened their seeds and died. A rosette, then, shows that the plant is either a biennial or a perennial. Many of the perennials, especially those of alpine districts, retain the rosette throughout life, throwing up a temporary stem each year to support and give greater prominence to the flowers; but with the biennials—plants that do not flower until their second year—the formation of the rosette is the work of the first year, and the following spring or summer it disappears gradually, the reserve material stored in it being used up in the tall leafy stem that carries the blossoms.



The Dwarf Thistle rarely produces any stem. It has a very close and compact rosette, beneath which no other seedling has a chance to grow, while its sharp prickles resist all attacks by downland sheep.

Many of the perennials—plants that flower several or many years in succession—have permanent rosettes, and every green waywayside or patch of waste ground will afford us examples. The most familiar of this class, of course, are the plantains and the daisy; but here it may be inferred that there are other reasons for the rosette. The plant wants a "place in the sun" and objects to having the vital light shut out by the grasses and herbage around it. By spreading widely and as close to the earth as possible it shuts out the light and warmth from any seeds that may be underneath, preventing their germination and growth.

Another reason may be found in any pasture where sheep or cattle are turned out. If we examine a patch of grazing land, we shall find the grass cut off very short and left fairly uniform in height; but the rosettes of the daisies and plantains have escaped, because they sit too closely to the soil. Even the long, thin leaves of the dandelion are little affected. The daisy, whose leaves are rather small and unable to make a large rosette, covers a large area of ground effectively by the expedient of branching from the base, and the creeping shoots form separate rosettes that fit close up to that of the parent. By this method a few plants can form a large, connected colony. A somewhat similar plan is adopted by the seaside variety of the beautiful little sheep's-bit (*Jasione montana*). The normal form which brightens sandy heathlands is an annual, but the var. *littoralis*, found upon cliffs and sandbanks by the sea, is biennial. This branches from the base, and each offshoot forms a rosette in which to store material for use in its second year.

Our gardens—apart from our lawns, which if not well kept will provide us with plentiful examples of daisy, plantain and dandelion—afford us numerous rosette plants for comparison with the native forms. Among these are the auricula and London pride, though the latter is a wild plant in the West of Ireland. Now these represent the alpine type of rosette plants, and accord-

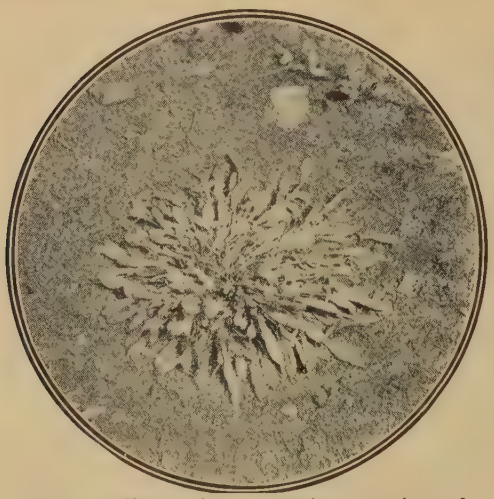
One of the handsomest rosettes is that of the Marsh Thistle; it can attain a circumference of eighteen feet, and its gaunt stem may rise in the second year to a height of eight feet.

ing to the books on structural botany, we find that it is a habit of growth adopted by plants subjected periodically or permanently to severe drought or cold. But though the rosette is characteristic of many alpine plants it is not restricted to those of elevated regions, for it will be found in damp meadows at no great height above sea-level. Although the two situations are so different, there are similar conditions affecting plant life in both. The alpine plant is liable to suffer from dry air causing excessive transpiration from its leaves, and the risk is much greater if the plant has a tall leafy stem. By suppressing its stem and bringing all its leaves close to the ground it is able to maintain a circle of earth cool and moist. As its breathing pores are on the lower surface of the leaves, they act in moist shade and the transpiration is not nearly so great as it would be if the leaves hung in the air, allowing the dry winds to attack the lower surface. Some take the additional precaution of rolling their leaves lengthwise to form a tube in which the breathing pores are kept moist.

These alpine plants commonly grow in thin soils where little water can be absorbed by the roots, so that the escape of water through the breathing pores must be reduced to correspond; otherwise the leaves will become limp and die. Even in the damp, deep soil of the lowland meadow, absorption of water is difficult in winter, and a tall plant growing amidst low grass would be exposed to serious risk of losing all its moisture by transpiration in such a wind-swept situation.

If we look at a tall plant like the very erect teazel, it is not difficult to see how the rosette condition from which it sprang was brought about. The broad, prickly leaves are given off in pairs at intervals up the flowering stem, the point at which they join the stem being known as a node, and the space between two nodes as an internode.

The Sow-thistle as here shown in the wheel stage. As the central leaves develop, the complete rosette is formed and the smaller plants now seen crowding between will be killed by deprivation of light.



The smallest of our native species of docks, the common Sheep's Sorrel, adopts the co-partnership habit. Either several individuals may unite in producing rosettes, or extensive colonies may be developed so that the rosette form is obscured.

material as it goes. They are there stored up in the rosette. That is the reason why we fail to find the rosette when the biennial plant has reached the flowering stage; its purpose as a manufactory and storehouse has been served, and every leaf has been drained of its useful contents.

Some plants that adopt the rosette habit, though they make pretty designs upon the ground, do not succeed in making really good rosettes, and the reason is that the leaves have long stalks. Of this kind is the lady's smock, the sanicle and the round-leaved sundew. The design they make is more strictly a wheel pattern. This, however, merges in the rosette, and some fine rosettes begin as wheels. It is among the composite plants that we find the best examples of the rosette, and the finest of these are to be seen among the thistles.

The dwarf thistle (*Carduus acaulis*) that freely decorates the grass of our chalk downs rarely produces any stem; if it does it

Now, if we imagine that in the growth of a plant it puts out the normal number of leaves but fails to develop the internodes, the result will be a rosette. This is what actually happens; and if in winter we look along hedgerows where the dry stems still stand crowned by their spiny seed-heads, we shall find near by on the ground the fine rosettes that are the newer generation of teazels. The long, broad leaves are spread out symmetrically, a row of spines along each side of the midrib serving to ward off the attacks of browsing beasts.

This winter form of the young teazel may be taken as typical of the temporary rosette of biennial plants; the stem is there, but reduced to its least possible length. In summer the growing point at its centre begins to lengthen, and continues, with nodes and internodes, until it is six feet or more in height. The growth of this substantial, prickly stem is comparatively rapid, because the plant has not, as in the case of annuals, to manufacture its building

A striking rosette of the downlands is that of the Viper's Bugloss. Examples of diameters of four to five feet are met with, and the greyish undivided leaves are protected from browsers by a fringe of sharp prickles.

*Photo: Henry Irving.*

**LADY'S SMOCK.**

Some plants, including the Lady's Smock, do not succeed in making really good rosettes, and the reason is that the leaves have long stalks.

Some of the British perennials produce permanent rosettes, among which may be cited the common Primrose.

measures only a few inches. As a rule we find only a very close and compact rosette about a foot across, nestling close to the earth, of very dark green hue, with exceedingly sharp prickles pointing in every direction, so that it is impossible to touch a leaf with a finger-tip without drawing blood. Right in the centre of the rosette lies the solitary bright purple flower-head, conspicuous to bees because of its dark surroundings and in spite of its low setting. Never a seedling has a chance of growing from beneath this close rosette; and the downland sheep may nibble close up to its margin, but they dare not mutilate a leaf of it. The small size of this rosette is due to the fact that no tall stem is produced, so the leaves, not being required for storage of much material, are short. In this case the rosette is not temporary, but continues throughout the life of the plant.

The splendid spear thistle (*Carduus lanceolatus*), which later throws up a branching, many-flowered stem four or five feet in height, forms a rosette twice the size of that of the dwarf thistle, and every leaf is tipped with a sharp bayonet. A fully-developed rosette of this species is a beautiful object at all times, but in early morning, when it is jewelled with dewdrops or powdered with hoar frost, it is a sight to be remembered.

Another very fine rosette marks the first year's activities of the musk or nodding thistle (*Carduus nutans*) of our chalk downs. Although the flowering stem it has to provide is often unbranched, it is very stout and may be five inches in height. Moreover, its scented, crimson flower-heads are very large; so that its handsome rosette is large also — three feet or more in diameter. Larger still is the fine rosette of the marsh thistle (*Carduus palustris*), whose gaunt stem of the second year may rise to a height of eight feet. The photograph on page 393 was taken in the autumn of 1922, on land that had several times been swept by fire in the dry summer of 1921, so that its eighteen-feet circumference was free from contact with other plants.

Our native species of scabious, allied to the teazel, and not far from the composites, also produce rosettes, but whilst the leaves forming them are undivided, the later stem leaves are broken into lobes. The sow-thistles, too, though their leaves are thinner and of more delicate texture, make rosettes of very pleasing design. They may be found in the waste corners of fields and along hedge-banks. One in the making is shown in the photograph on page 393 at present in the wheel stage, on a bank among violets and other plants. It is easy to see that, with the filling up of the open spaces in the wheel by the development of the young leaves shown in the centre, many of these smaller plants will be killed out by deprivation of light.

A striking rosette of the downlands is that of the viper's bugloss (*Echium vulgare*), fine examples being four or five feet across, the greyish undivided leaves

protected from browsers by a fringe of prickles along the edges and others arising from low warts all over the surface. As an example of the small rosette plants, we may refer to the very common sheep's sorrel (*Rumex acetosella*), the smallest of our native species of docks. Here several individuals may unite to form a tolerably symmetrical rosette; but often they grow in such extensive colonies that the rosette form is obscured.

Some of the perennials produce permanent rosettes, of which two notable tall-stemmed examples are the burdock and the milk thistle (*Silybum marianum*), both with broad leaves. A very pleasing one of this class found along every wayside is that of the silverweed (*Potentilla anserina*). Others will be found in the butterworts of bogs and wet mountain sides, the familiar cowslip and primrose, and the less-known though very plentiful sanicle (*Sanicula europœa*) of the woods.

If one takes only the examples we have mentioned, it will be seen that the most complete rosettes are compounded of stalkless or very short-stalked leaves. Where the leaves have moderately long stalks one purpose of the rosette fails, for the open spaces between them let light through to the earth, enabling competing seedlings to spring up and choke the rosette-plant. The sanicle is a case in point, but, though there are many variations from the exact flat rosette, the frequency with which this form is adopted is a testimony to its value in plant life.

Somewhat similar to the rosettes in the objects to be attained by their special growth-form, are the cushion plants, of which examples are to be found among native species. Perhaps the most familiar of these is the thrift (*Statice maritima*), so abundant on our sea cliffs as well as high up in the mountains. Each plant forms a close, rounded boss of vegetation; and if the tough, woody rootstock be pulled from its crevice in the rocks, it will be seen that the plant has achieved its end by the production of many dwarf branches, each densely clothed with stiff, grass-like leaves.

In this article we have attempted merely to sketch the general reasons for the rosette. In his rambles the reader, by keeping an eye open for examples, will be able to add materially to our list, and by noting the conditions under which particular plants are growing may discover special reasons, other than those suggested, for the adoption of this form. It is only by such careful observation of living plants under natural conditions that a full knowledge of our native flora can be obtained; the handbooks on the subject usually, for the most part, give merely the dry details necessary for the identification of the many species.

The small Scabious produces rosettes whilst the leaves are undivided; the later stem leaves are broken into lobes. The lobed leaves, as shown in the illustration, belong to a second-year plant (flowering), which has been covered partly by newer rosette.

*Photo: Henry Irving.*

The Sweet Violet's habit of hanging its head is part of its particular scheme for securing fertilization and by no means due to excess of modesty, as the poets insist.

# 9.—THE SECRET FLOWERS OF THE VIOLET

By G. CLARKE NUTTALL, B.Sc.

"BOTH the tame and the wild violets are so well known that they need no description," wrote old Dr. Culpeper, from "My House in Spitalfields next door to the Red Lion," in Cromwellian days, but it is quite certain that this lofty superiority was very wide of the truth both then and now. He and many successive generations knew nothing of the subtleties of their pretty, well-known blossoms, while as for the violet's "secret flowers," imagination's wildest flight never compassed them! His further condescending remark that they are "of a mild nature," shows how greatly he underestimated the true inwardness of the violet's character, for if ever a plant might be called thoroughly ingenious in its efforts to secure a worthy posterity, that plant is the violet. The mechanism of the purple blooms alone is a revelation in intricacy of design to effect a given end—the interchange of pollen between flowers on the same plant, or better, between flowers on adjacent plants—while the production of the aforementioned "secret flowers" as a second string to its bow is a stroke of genius.

Consider first the points of the scheme ordained for the purple flowers of the sweet violet, noting that the blossom hangs its head as part of that scheme and not from excess of modesty, as the poets insist. The five purple petals are arranged two above, two at the sides, and one—larger—as a platform below, this larger one being produced backwards into a long and deep pouch. Directing lines on this platform lead to the centre of the petal ring. Within the petals are five big-headed stalkless stamens, boxes

of floury pollen dust, two of which have long thin spurs running off their backs into the petal pouch. This ring of stamens forms a circular wall surrounding a chamber, and inasmuch as the pollen boxes open inwards it follows that, eventually, the pollen must all fall into this chamber. The thin spurs are each tipped with a honey sac oozing with sweetness which is thus tucked away at the extreme end of the pouch. In the centre of all is the case of seeds-to-be from which projects a little green column with a kink in it and a knob at the top. As the flower is hanging downwards this knob forms the floor of the central chamber.

Now an interchange of pollen between flowers obviously necessitates messengers, and the messengers here in view are butterflies and bees, for choice the bee *anthophora* with its long, slender proboscis, four times longer than that of the hive bee. The violet's intention is that a potential messenger, attracted by the colour and the fragrance, should alight on the petal platform. Directed by the lines on that resting-place, it pushes its proboscis into the centre of the flower, perforce knocking its head on the green knob. With the pressure on the knob the kink in the column supporting it acts like a spring, and the knob —the floor of the chamber—gives way and out drops a shower of the golden fertilizing pollen on to the insect's head while it is sipping the nectar deep in the pouch. Satisfied, *anthophora* departs, his head all dusty, to press and incidentally smear the green knob in an adjacent blossom; to gather the nectar there, and to receive another pollen baptism, and so on in unending sequence. The pollen grains, resting on the knobs, grow out into long tubes, piercing the tissues of the "kinked" columns and pass on their contents to the waiting ovules which are thus fertilized to carry on a violet posterity.

It is a marvellously ingenious scheme, if it always came off, but for the most part it does not. As Shakespeare says, there is such a thing as "Vaulting ambition which o'erleaps itself, and falls on the other [side]," and the violet has really rather over-reached itself. The scheme is too elaborate, and one little point has not been sufficiently adjusted, namely, the violet will persist in flowering before the bees and butterflies are really quite ready to face the spring's uncertain moods. An odd one or two may flit about, an occasional blossom develop to maturity, but in the majority of cases these deep-laid plans, like the best-laid schemes of mice and men, "gang aft agley."

*Photo: G. Clarke Nuttall.*

The "secret" or "blind" flowers of the Violet never flaunt in the sunshine, but look merely like unopened green buds: *a* represents the little insignificant bead-like flower passing by stages *b*, *c*, *d*, *e* to *f*, the well-formed and familiar seed capsule.

But is the violet downhearted? No! A plant with the violet's capacity for resource is not so easily done. It has its "secret" or "blind" flowers in reserve, flowers never recognized as blossoms, flowers that never flaunt in the sunshine or exhale delicious fragrance or yield sweet honey. They, indeed, are the modest flowers of the plant, for they lurk close to the ground or cluster deep under the leaves, and they are completely deceptive, for they look like merely unopened green buds. Their ways, too, are ways of secrecy; they never open or attempt to allure messengers

*Photo: G. Clarke Nuttall.*

The Violet has yet another way of propagating itself. It sends out long runners or stolons, which at certain points put forth roots and start new little plants. Here **A** is the parent plant, and **B** one of the daughters which it establishes at a little distance from itself in all convenient directions. Eventually the connecting "runner" dies away and the plants are quite separate.

or desire outside help. They are self-sufficient, and, fashioned on direct simple lines, they arrive at their destined end—the provision of seed.

For within these green buds are simple stamens full of pollen and a simple seed-case containing potential seeds, and in the cool darkness of the bud the pollen falls straight from the stamens on to the receptive surface of the stigma and thence to the ovules. There is no finesse, no colour, scent or honey, no chance messengers to hang fate upon. There is no opportunity for miscarriage of plan. Botanists call these flowers "cleistogamous," from two Greek words meaning "closed" and "marriage."

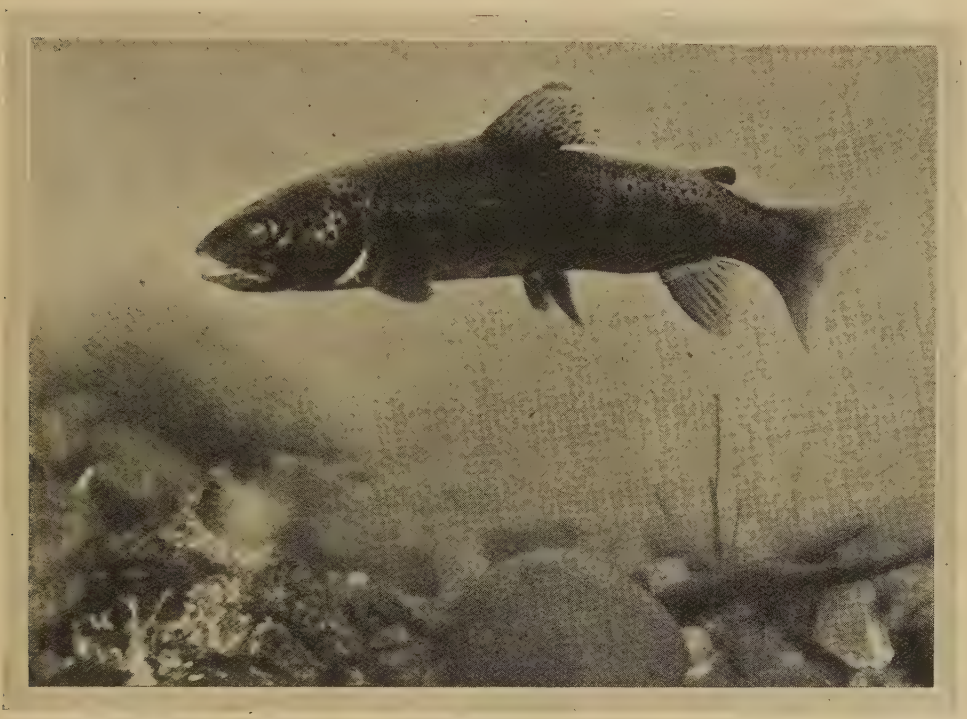
The days pass, fat capsules full of little black seeds replace the "secret" flowers. The violet plant is in fruit, and passers-by give all the credit for it to those charming, sweet-scented spring flowers that delighted them earlier in the year, and quote approvingly the designs of Nature as exemplified in them. But they are completely wrong. In only one of the British species of viola, *Viola tricolor*, the little heartsease, can the pretty coloured flowers be relied on to set seed. In almost every case, if we trace the origin of the fat capsules, we find that the parent was one of these curious little hidden or cleistogamous flowers.

One further touch of violet ingenuity can be seen even in the last stage of the capsules' life. As they dry and brown they split and open back into three rays, revealing a double row of shining black seeds in each ray. The wall tissues continue to shrink with increasing pressure upon the seeds until the limit is reached, and, suddenly, the little black objects are shot out one after another, and thus dispersed to carry on the race of violets to unnumbered generations.

But even these secret flowers do not satisfy the violet's determination to propagate itself; it has yet another plan in the background. From the plant will grow long thin "runners" like green cords, which, at a little distance away, will send roots into the ground and each start a daughter plant that will grow into one precisely like its parent. But this method of reproduction has a certain limitation; from a seed a new variety, or a "sport," may possibly arise, but from a runner this can never happen.

*Photo: G. Clarke Nuttall.*

*Viola tricolor*—the Heartsease—is the only British species of Viola whose ordinary flowers can be relied on to set seed. Here the process after fertilization is shown: the petals fade and fall; the capsule grows; finally it splits into three and shoots out its seeds.



Although officially described as an adult Brown Trout, he had a brilliant gold and yellow body with spots which resembled jewels buried in the skin.

# 3.—THE LIFE STORY OF THE BROWN TROUT

By DR. FRANCIS WARD, F.Z.S.

With photographs by the Author

HE was known as "Thomas."

Thomas was a fine brown trout that had spent the summer in a Hampshire chalk stream, close to a hatchway.

Though brown trout was his official description, in appearance he was a brilliant gold and yellow, and the spots on his body resembled jewels buried in the skin.

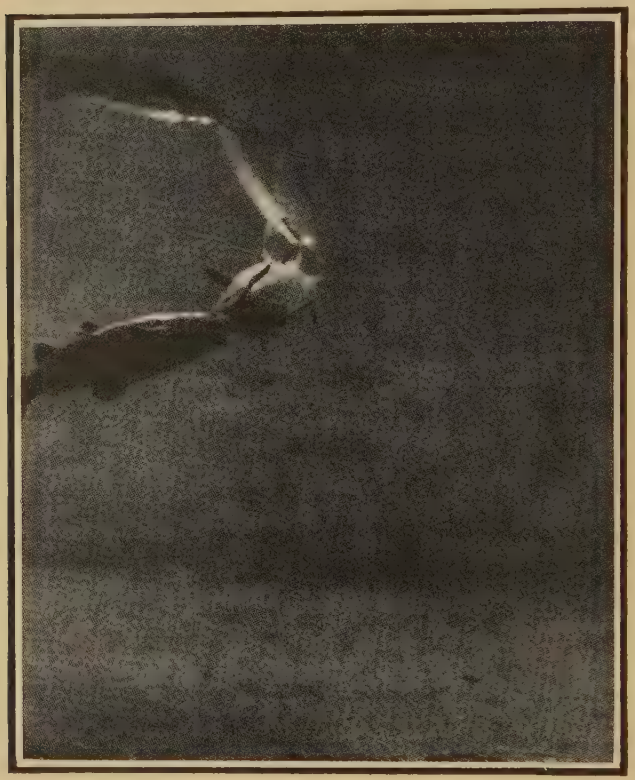
The water in which he dwelt was rented by six London anglers. All experts; they had rods from the best British and American makers. Flies tied by the leading tackle firms, flies tied by themselves, flies that were perfect copies of the natural fly, and flies like nothing on earth. Yet Thomas had been too much for them, and had got through the season without being brought to the net. True, he had been hooked on three separate occasions, but his tactics had always been the same. One wild rush up the hatchway, sharp to the right behind a

post, a violent shake of the head, and he was free to rub the fly from his lip at his leisure.

* * * * *

Kilweil is a glorious stretch on a northern stream. At the top of this stretch the river flowed as a long unbroken flat, over a bed of stone and rock which sloped gradually to deep water under the opposite bank. The river then narrowed down to race round a bend to the rapids below. At the bottom of the race, under the bank, was a deep pool of slack water with a back eddy, the result of a fallen tree of which half the roots were submerged. Between the slack water and the racing river another "Thomas" fed. Though this fish was not known as Thomas, it was not long before the latest rod to arrive on the water had heard of the big trout of Kilweil.

This trout had also got through the fishing season in safety; the submerged roots had been his salvation.



In the final round of the fight, when both fishes appeared to be exhausted, the attacked Trout rushed at his enemy, gripped his lower jaw, and shook him as a terrier does a rat.

It was now well on in October, and Nature sent the same message to Thomas of the chalk stream and his brother in Kilweil: "Find a mate and go up-stream to spawn." So these fish became restless and wandered up and down the water, and in due course answered to Nature's call.

Let us follow the experiences of the Kilweil fish. He left his pool below the fallen tree and worked his way up through the flats, keeping in the deep water under the bank. Here he met other trout doing the same. Some instinct told them that they would soon be able to run up, and sure enough in a few hours' time the river began to rise. It had been raining up on the hills, and now the flats were pitted with heavy raindrops.

In a few hours the river was in flood, and all the fish, including the trout whose fortunes we are following, worked their way up, keeping close to the bank in order to avoid the force of the current. But the wind changed and the rain ceased, and that northern stream fell as rapidly as it had risen. So the Kilweil trout found himself in a long, deep pool, into which the water from above tumbled over rocks and boulders.

It was obvious that further progress was impossible until the river rose again, so he looked about and presently found a mate that attracted his fancy. After some persuasion, including a judicious bite or two, he induced her to accompany him, and happy in each other's company they swam about together in the long pool.

The idyll, however, did not last very long. Another trout was stranded in that same pool, and with sinister intent he cast his eye upon the bride to be. Without any warning he rushed at the male trout and bit him on the back. Kilweil was round in a second and, put on his mettle, set to and chased his aggressor all over the pool. Now and then he would get in a bite on the

tail, but at last the retreating fish turned and gripped him by the jaw. For a while they clung on, shaking each other at intervals, and then, as if to say: "That will do for to-day," parted as suddenly as they had begun. Our trout went back to his mate, and his rival nursed his wounds in sulky isolation. The same sort of thing happened two or three times on the following day; but on the third day the Kilweil fish knocked his opponent out.

It happened in this wise. After a long-roaring flood. By gradual stages, as the water permitted, Kilweil and his mate reached the head waters and the spawning grounds where both of them had been before.

The male fish now became very attentive, and as his mate rested on the gravel he tried to entice her to spawn. After a time she began. First she turned on her side, and with a rapid flapping action of her tail threw back the shingle, leaving a hollow, technically known as a "redd." Some of her

A week after the fight the Brown Trout and his mate reached the spawning grounds. As the latter rested on the gravel, the former enticed her to spawn. Turning on her side, she threw back the shingle by flapping the tail, and made a "redd," or hollow, into which some of her hard roe or eggs escaped.

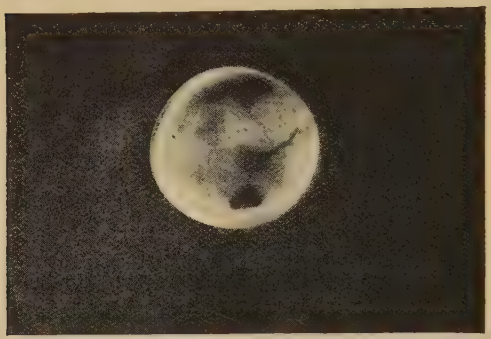
continued fight, when both fish appeared to be exhausted, Kilweil suddenly pulled himself together, rushed at his enemy and got a really good grip on his lower jaw. Over and over they rolled in the struggle, and every time they stopped Kilweil shook his now utterly exhausted opponent as a terrier shakes a rat. Then he let go and, exhausted himself, swam slowly away.

The vanquished trout turned on his back and floated to the surface. After a time he recovered sufficiently to right himself, and wobbling from side to side, managed to get to the shelter of the bank, probably deciding thenceforth to leave other people's domestic happiness severely alone.

A week later the river came down as a

hard roe or eggs escaped into this hollow or trench. She then moved forward a few inches, and with the same flapping movements made a fresh trench, the gravel from which was thrown back over the eggs first deposited. Meanwhile the male, who was near-by, shed his milt or soft roe into the water, the sperms from which impregnated the eggs before they were covered. With intervals for rest, the female trout continued to spawn for three days. She weighed about a pound and a half, so some fifteen hundred eggs were buried beneath two or three inches of gravel, over an extensive area.

Her duty done, the exhausted fish dropped down-stream. Her mate stayed for a time



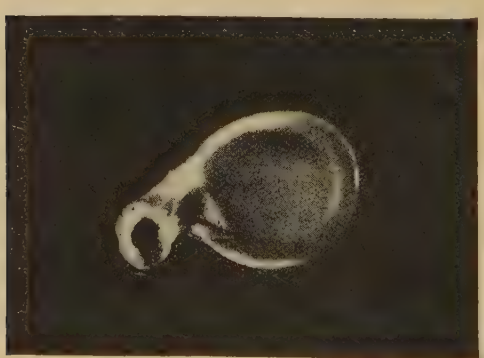
In six weeks two black spots—the eyes—were visible under the covering membrane of each fertile egg. Six weeks later still, as shown in the photograph, taken an hour before hatching, the young Trout was ready to emerge.

on the edge of the spawning ground, but he, too, left before the year was out.

Meanwhile the oxygen-laden water of the sparkling stream made its way in little eddies down to the buried eggs. In six weeks two black spots were visible under the covering membrane of each fertile egg. These were the eyes. Another six weeks and the young were ready to hatch.

For some days the little prisoners had been finding their quarters too confined. They struggled and wriggled and went round and round in the encasing " shell," when suddenly the membrane split and out popped a head or a delicate tail.

In the illustration of a trout hatching, where the head has just escaped from the enclosing membrane, the heart is shown as a dark spot with a blood-vessel on either side of it. The swish of the body as the little fish struggled to escape is also well illustrated.



The head of the Trout hatching has just escaped from the enclosing membrane, the heart is shown as a dark spot with a blood-vessel on either side of it. Note the swish of the body in its effort to be free.

The next photograph shows the yolk-sac nipped ; this caused delay in hatching. It will be seen that a constant fanning movement of the pectoral fins—one on either side of the head—is kept up to ensure a supply of fresh water around the embarrassed young fish.

A curious incident in the hatching of a Trout when the yolk-sac was nipped. The pectoral fins, one on either side of the head, keep up a constant fanning motion to ensure a supply of fresh water around the embarrassed young fish.

A trout when first hatched is known as an alevin. Attached to the undersurface of its body is a huge yolk-sac—a natural feeding bottle, upon the contents of which it exists for the first five or six weeks of its life.

At first the alevin, exhausted with the exertions of hatching, lay panting on its side, but presently it sat up and rested on the yolk-sac.

The little fish dislikes light, and when not sufficiently covered he burrows deeper into the gravel. Here the continuous fanning movement of the pectoral fins, already

referred to, causes a current round the alevin, as he lies buried in the stones, and the water vitiated by his breathing is carried on. Only a small percentage of the eggs buried on the spawning ground result in the birth of an alevin, and these themselves are decimated by their numerous enemies as soon as they escape from the gravel.

When first hatched a Trout is known as an Alevin. A huge yolk-sac is attached to the undersurface of the body, and functions as a natural feeding bottle for the first five or six weeks of the Trout's life.

Sometimes the eggs are insufficiently covered and are washed out of the redds, to be quickly devoured by the young trout who are always on the prowl. Late spawners frequently expose eggs already deposited, while ducks, water-hens, rats, eels, insects and various larvæ all take their share of the spoil. Floods may cause countless ova to be buried feet deep under gravel and debris; or should the water shrink, the eggs may be left high and dry. Finally, in a sharp winter the water over the redds may freeze, and when the ice moves it takes with it gravel, buried eggs and all.

If all goes well and the alevin hatches in the gravel, he is in comparative safety so long as he remains buried.

At five weeks old his yolk-sac has been almost absorbed, and the young fish leaves the gravel. By day he begins to swim about and feed on minute infusoria; by night he takes shelter under shelving stones or other protection. Now stickleback and various young fish take their toll, while murderous-looking larvæ and caddis worms crawling in after them still further diminish their numbers. As the alevin grows he adds cyclops, water-fleas, and other small crustacea to his dietary.

At seven to eight weeks old all trace of the yolk-sac has gone, and the alevin is known as a "fry." Water spiders, beetles, freshwater-shrimps now become part of his menu, and occasionally he has an opportunity to nip off the head of a caddis worm before it has time to withdraw into his protecting case.

The young Trout Alevin at five weeks old, having almost absorbed his yolk-sac, leaves the gravel, and begins to swim about by day in search of minute infusoria as food.

The following year is a perilous one for the fry, but should he escape his numerous enemies, by next spring he becomes a "yearling," and is now three to seven inches in length, according to the amount of food he has been able to get. The following year he is five to twelve inches long, and is now a "two-year-old": in the autumn of that third year he goes up to spawn.

In consequence of his numerous enemies a trout seldom reaches old age. Even such a sagacious fish as our friend of Kilweil seldom dies in his bed—in other words, at the bottom of a pool. Kilweil's death was tragic. The autumn after we left him, he was travelling up to spawn on a moonlight night. As he was working his way through some rapids the water splashed on his broad back, which was partly uncovered.

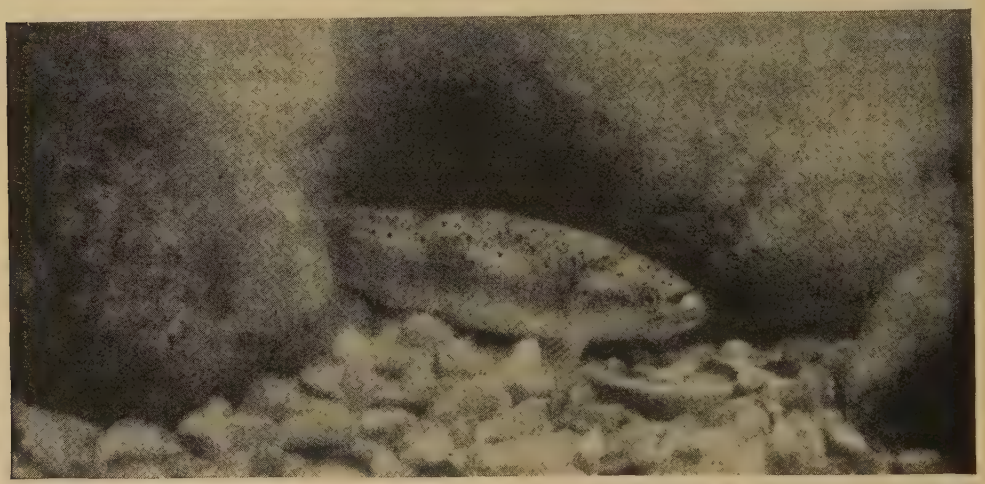
A heron fishing near the bank noticed the splashing. Stealthily she stalked up behind him. Kilweil felt a stinging blow; he had been stabbed by the bird's closed bill as effectually as if it had been a bayonet. But the great fish was of no use to the heron; she had struck him wantonly and then she left him.

Sick and faint, the quivering trout dropped into the pool below. During the night he died; and in the morning two land rats that had come down for a drink found his body under the bank.

* * * * * *

The interest of the photograph on this page lies in the strange markings on the trout. As will be seen, the trout shows a broad dark band along the side of the body, with three or four irregular dark patches radiating from this dark band on to the back. These are "fear" marks.

When a fish is alarmed it pales, due to a contraction of the dark colour cells in the skin. Apparently with the trout, though the rest of the body pales, the cells in the areas described remain relaxed, hence the dark markings. This scheme gives the trout a blotchy appearance which, presumably, is intended to assist in his concealment.



The broad dark band along the side of the Trout's body, with three or four irregular dark patches radiating from this band to the back, indicate "fear" marks.

The last two illustrations tend to confirm this suggestion.

At one time a brown trout constantly lay in front of the window of one of my observation chambers. I was in position under water, and being invisible to the fish he remained as usual without any sign of blotchiness. Presently my man came to the edge of the pond, and I watched that trout gradually change to the appearance as shown in the upper photograph on page 407. The man at my instructions frightened the fish away. In three to four minutes the trout returned, he had forgotten the cause of his alarm, and all the dark marking had disappeared.

This blotchy appearance of a trout can often be seen from a river bank, as a fish dashes off the stones when the water is low.

Another example of the "fear" marks produced in a Trout.

Three minutes later the cause of the Trout's alarm had been forgotten, the blotchy marks had disappeared, and the fish had assumed its normal uniform colour.

# Curiosities of Insect Life

## 11.—THE WONDERLAND OF THE EARWIG

By JOHN J. WARD, F.E.S.

Illustrated with original photographs by the Author

THE "nasty, horrid earwig" is an insect that nobody loves. Perhaps that accounts for the fact that its life story has never before been told in detail, and recorded by means of the camera. In any case, although one of the most abundant of British insects, and perhaps the most familiar in our gardens, yet entomological and natural history works give nothing more than scrappy details of its metamorphoses. Nevertheless, it possesses a most remarkable life story, full of absorbing interest, and introducing some entirely new aspects of insect life, as I will here endeavour to show.

The mother Earwig tenderly arranging her first batch of eggs and placing them beneath the soil.—April 23rd.

Earwig revels begin just after nightfall. Throughout the day these wary insects keep under cover, but as soon as darkness falls (when there is no fear of robins, tits, and other foes) they may be seen backing out from the folds of leaves, the petals of roses, carnations, dahlias, etc., where during daylight they have been peacefully reposing. They love company, and quickly gather forces, which actively proceed to business.

The gardener the following morning will give you a full account of their doings; he will show you his violas, his pinks, his ox-eye daisies, and what not, all with petals sadly damaged, and, with anger in his eye, he will set up-turned tree-pots on canes amongst his dahlias and chrysanthemums to entrap them by offering them cover as daylight approaches; no good word will ever come from him when the earwig is in question; yet, after all, it would be well if he were to be more observant.

Black though things seem against the earwig, I am inclined to think that this insect has been sadly maligned. It is true that it will occasionally damage the petals of flowers, but a series of night investigations will, I think, conclusively prove that much of the damage attributed to it is really the work of night-feeding caterpillars and slugs. Damaged dahlia blooms are a particular grievance of the gardener against earwigs, but captive earwigs that I enclosed with various flowers and leaves, including dahlia flowers, left the dahlias quite untouched, while they ate to shreds dandelion leaves, also enclosed. The dahlia bloom is, I think, favoured by the earwig more on account of the shelter it provides than as a food plant; various species of moth larvæ of night-feeding habits play serious havoc amongst such blooms; also, many of the minute perforations found in the petals of flowers such as phloxes, chrysanthemums, wallflowers, etc., are the work of tiny flies with biting mouth-parts which operate throughout the day; but the earwig gets all the blame.

Sixteen days later she was excitedly raking with her fore-legs at a hole in the ground crowded with tiny Earwigs. The feet of her hind pair of legs are seen to be encased with dried mud "boxing gloves" to defend her young.—May 9th.

When a fortnight old the baby Earwig moults its skin, changing in about one minute to a silvery white insect. Its cast skin is seen behind it.—May 23rd.

A second batch of eggs was laid when the young were nearly half-grown; but that did not prevent the young from returning to the nest.—June 3rd.

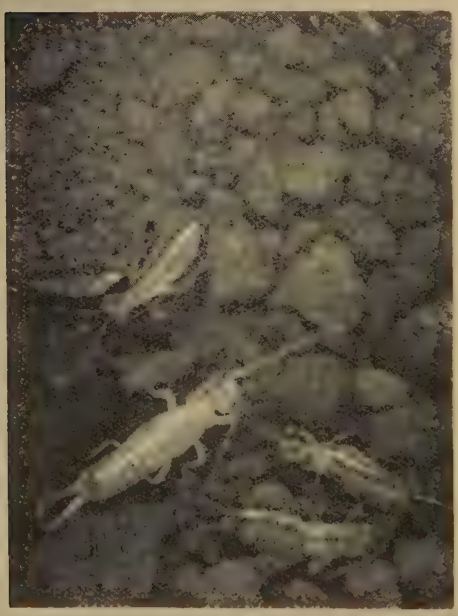
Two days later one of the family moulted its second skin, the next stage in development.—June 5th.

Even allowing that the earwig is occasionally destructive, there is another side to its story. It is one of nature's scavengers, and just how much good it does amongst the plants in our gardens is difficult to estimate. The night-roaming parties move up and down amongst the foliage and flowers, stopping here and there to remove particles of decaying matter; spots of sugary materials, and pollen fallen from the flowers on to the leaves; the bodies of dead insects; and other refuse, all of which, if left, would set up colonies of bacteria, fungi pests, moulds, etc. They provide the army of cleaners which appear after the banquet, when the gaudily-attired guests of the day have departed, to clear up the litter in readiness for the next day's feasting. The earwig is one of the most prolific insects in the garden, much more so than in the wild, because amongst the unhealthy plants under cultivation the services of the sanitary inspector are much more needed than amongst the native and more hardy plants.

Dissections of earwigs under the microscope show their stomachs to be full with aphides, thrips, caterpillars, small slugs, and the remnants of the egg-shells of many injurious insects; and although they also indulge in a vegetarian diet, that is probably

The mother Earwig doing her best to hide her second batch of eggs in the soil, and to give attention to members of her first family.—June 5th.

Just before the third moult the young Earwig begins to develop wing-cases, as shown in the lowermost example; the others are not quite so advanced.—June 17th.



After the third moult the Earwig increases in size, and once more assumes a silvery white colour.—June 20th.

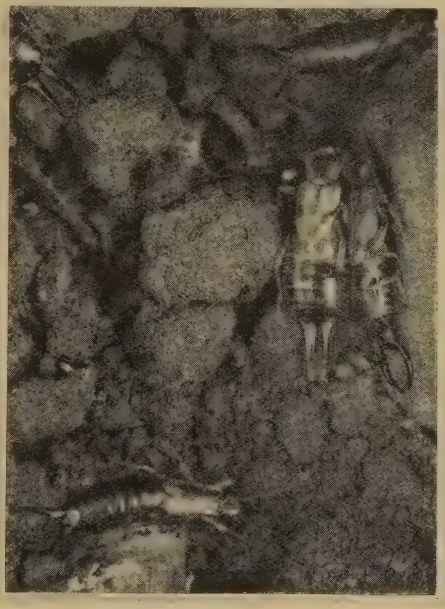
The mother Earwig with her third batch of eggs.—June 25th.

the outcome of too effectual scavenging work, together with their increasing numbers, having produced a shortage of their more normal food supplies ; to which must be added temptations in the form of delicate plant tissues with which under natural conditions they would be unlikely to meet. If I had to classify the earwig I should without any hesitation place it amongst the useful insects of the garden, and that in spite of any local damage that may occasionally be proved against it ; we must recognize, too, that every labourer in the garden is worthy of his hire.

Then there is the libellous implication that the earwig enters and penetrates the human ear. If an earwig ever did enter a human ear, it would be for shelter, just as it might crawl into the folded petals of a flower, or the gardener's tree-pot traps ; and any person so invaded would surely have to be asleep. It would, however, be a very enterprising earwig that would attempt to penetrate the ear, and it would very soon desist, as it could certainly not find anything attractive in that direction. The whole idea is an ancient superstition founded probably on the name, which is said to have been originally " ear-wing "—from the resemblance that the earwig's wing bears to the human ear. It is a curious mistake, which seems to have caused an abiding, unreasoning aversion to this insect.

In the first photograph the mother earwig is seen tenderly arranging her batch of eggs, and placing them in a hollow in the ground, so that she can cover them with the foreparts of her body. The mating appears to take place quite late in the year, even in December, and afterwards the female earwig hibernates in sheltered crevices, beneath stones, or between old wood-work. Towards the end of March she burrows into the soil, and soon afterwards deposits from forty to sixty pearly-hued eggs. If she is disturbed and her eggs scattered, she will rapidly gather them together again, and convey them beneath the soil. Her eggs are slightly adhesive, and by holding one in her mandibles she can often carry a dozen or more together, collecting the scattered ones later. Perhaps an hour afterwards she will be found head downwards, half buried in the soil, guarding her eggs, only her tail pincers projecting, like a pair of formidable biting jaws at the mouth of her burrow. That, I think, is the chief function of the tail pincers, as any inquisitive organism that approaches too near immediately receives a sudden thrust from these weapons, followed by a sharp pinch should it be too persistent.

Since so little was known of the early stages of the earwig, I isolated the mother insect shown in the first photograph together



At the end of the first week in July some of the Earwigs hatched on May 9th had reached maturity. On the right two adult insects are seen. Beneath them is one which has yet to make its final moult, as its short wing-covers show.—July 7th.

with her eggs, and kept her under close observation. She was continually moving her eggs to different parts of the soil, where it was more moist, or more dry, best to suit their development. One morning, sixteen days later, I found that, during the night, her forty-eight eggs had disappeared, and she was very excitedly raking with her forelegs at a hole in the ground crowded with tiny earwigs, which immediately swarmed amongst the soil she was turning over. Sometimes one would stray from the hole—as one is seen doing in the photograph at the top of page 409—but it would soon return, as they are gregarious feeders.

This maternal care in insect life is very remarkable, as they rarely do more than deposit their eggs in suitable situations for their development; although in some cases, as in bees and wasps, they add a supply of food material for the grub when it hatches from the egg. Here, however, we have the true maternal instinct developed to a very high degree, and far in advance of that exhibited by any other British insect.

The fourth, and last, moulting of the skin is an astonishing performance. Here the Earwig is seen on a dandelion leaf pushing off its last skin and withdrawing its snowy white body, legs and long-jointed feelers; but it has jet-black eyes.—July 10th.

Still more wonders were to follow.

In the top illustration on page 409 it will be seen that the feet of her hind pair of legs are enveloped in well-shaped, hardened masses of mud. Just how these were formed I was never able to observe, but it was no accidental accumulation, for her first and second pairs of legs, with which she raked the soil, never collected such masses. When she moved over the surface of the soil she dragged these mud-laden feet behind her, not using them for walking. What, then, was their function?

When she was tending her young in the hole one of these mud-covered feet rested on each side of her elevated tail pincers, and, when I touched the latter, she adopted the usual device of a prod with those organs, but a second touch brought her "boxing glove" on that side into play with a savage kick that would have been quite sufficient to dissuade any ground-beetle larva, or similar foe, from intruding its nose any farther in that direction. A day or two later I noticed that one of her hind-feet had lost its mass of solidified mud, and the following morning it had been replaced with a new covering; but when the young were about a week old she entirely disposed of these weapons.

When a fortnight old, each little earwig, one by one, moves a little distance away from the crowded nest while it moults its skin, changing in about one minute to a silvery white colour, which gradually tones until at the end of an hour it assumed the ordinary dirty grey, or blackish, colour. After moulting, it immediately returns to the nest.

The young were hatched on May 9th, and on June 2nd they still crowded round their mother while she conducted them to new feeding grounds. It was then that their scavenging work below ground became apparent; all kinds of decaying vegetable and animal substances were consumed, and over-ripe squashed fruit was eagerly devoured. What the tiny earwigs feed on amongst the plain soil just after hatching is difficult to understand, probably it may be some bacteria, or minute particles of organic materials which they discover there.

On the morning of June 3rd another surprise awaited me, for, on looking at the nest, I found another batch of eggs had been deposited, numbering thirty-eight in all, amongst which some of the now nearly half-grown young were resting, the mother insect being then away from the nest—trying to find another place in which to hide her new batch of eggs away from her half-grown young, as I discovered later.

Eventually the mother returned to the nest, and, apparently, she did not make any objection to her young crowding around her and her newly-acquired eggs. She continually caressed them with her feelers, and promptly warned them of approaching danger, bringing to a sudden halt the activities of the whole group, as she had always

When the cast skin reaches the tail-end, the tail pincers manipulate it until it is discarded ; then—

done ; a most astonishing action, seeing that she can touch only a few of them ; probably the individuals touched convey the alarm to those beneath them.

Two days later still (June 5th), yet another surprise awaited me. On top of the eggs and half-grown young a very large silvery white individual appeared. This was the first of the young to make its second moult —the next step in its development.

Presently the mother insect returned and proceeded to arrange and hide her eggs, and there she was, doing her best to cover them, and at the same time give attention to those members of her family which occasionally crowded round her (page 410).

The following day there was a greater surprise than ever in store, for the whole batch of eggs had disappeared excepting the parts of two broken shells ; yet the mother earwig was, as usual, tending her rapidly-growing young. As both she and her offspring were enclosed in a close-fitting metal case with a glass covering, to which no foe could possibly gain access, there was only one explanation—her young family had eaten the eggs during the night. That was unfortunate, because it would have been interesting to have seen if the second batch of eggs had proved fertile, as no mature male insect could possibly have reached her. There were only the immature males of her own family, which were sexually imperfect. It is quite probable that the eggs would have produced a second family, for such instances of apparently unfertilized eggs producing offspring is the phenomenon known as *parthenogenesis*, which is familiar in some groups of insects ; but in this case it had to be proved.

Now we realize why the mother earwig so carefully guards her eggs. Instinct evidently did not guide her to drive off her own offspring, as it would in the case of other normal intruders seeking her eggs. Also, we incidentally learn that young earwigs devour insects' eggs which they find below ground—even though they may be those of their own species.

Had the mother insect been free, she would doubtless have left her growing family when she was about to deposit her second batch of eggs, as its members were then well able to fend for themselves, and in that

—the ghost-like Earwig, nearly half as large again, rushes joyfully back to rejoin its relatives, who have yet to undergo their final change.

On July 10th the mother Earwig's third batch of eggs commenced to hatch out another family of silver-white Earwigs.

manner she would have checked the cannibalistic traits of her offspring. Probably those mud-laden hind-feet, which, it will be remembered, were developed during the hatching of the eggs period, may be the means of protection from egg-raiding parties of the young of her own species.

By the middle of June the young earwigs are nearly ready for their third moult ; and with each shedding of a skin a big advance in development is made : for there is no caterpillar and chrysalis stages in the case of the earwig. In the second photograph on page 410 a group of them is shown, for they now congregated in small groups in various areas of the soil and beneath stones ; neither could they associate with their mother, as I had removed her into new quarters where she was alone.

Just before the third moult takes place, the developing earwig begins to assume the form of the adult imsect, with rudimentary wing cases. The lowermost earwig in the photograph just referred to has attained that stage, but those round it are not yet quite so advanced.

It was on June 20th when the first of the family moulted its third skin, and it is shown in the lower left-hand photograph on page 410. It now more nearly resembles the parent insect, and once again it is silvery white, but only for a short period, as it quickly changes to the amber brown colour of the full-grown insect.

On June 25th I found the mother earwig, whom I had placed in isolation, busy with a third batch of eggs (page 410), but this time they numbered only twenty-six. Since she now had no young to disturb her, here was an opportunity to see if these successive batches of eggs produced without the intervention of the male insect would prove fertile.

Some of the earwigs hatched on May 9th reached maturity on July 7th, when they made their fourth and final moulting of their skins. On page 411 several of the fully-developed insects are shown ; but the lowermost one has yet to cast its last skin, as indicated by its smaller wing-covers.

The final moulting is a most astonishing performance. An individual such as that shown lowermost on page 411 leaves its fellows and selects some undisturbed spot. In the example photographed it preferred the surface of a dandelion leaf which was resting on the ground. By some sudden muscular contraction the skin at the thorax portion, just behind the head, is caused to split, and through the opening immediately appears the head of a snowy white earwig with jet-black eyes. In a moment or two it is seen to be withdrawing its legs and long-jointed antennæ, as shown on page 412, its legs pushing off its old clothes until they reach the tail pincers, which organs afterwards manipulate the shrunken skin on their own account (page 413), eventually

The next day she was busy at her burrow seeking food for a crowd of baby Earwigs.

casting it aside; then the ghost-like earwig rushes joyfully back to rejoin its relatives (page 413), being nearly half as large again as it was perhaps only a minute previously.

It has now attained the adult form, and in the course of an hour it becomes quite an ordinary earwig clothed in a suit of deep, glossy amber colour. The insect whose emergence from its final skin we have witnessed is seen to have broad calliper-shaped pincers, toothed at their base, differing in this way from the mother insect. These characteristics indicate that it is a male.

On July 9th the mother earwig showed great agitation when I approached her, and she proceeded to bury her eggs more deeply. Surely instinct would not guide her wrongly to take so much care of unfertilized eggs? It was now fourteen days since she laid this third batch of eggs, so they should soon hatch out their young, if they were going to.

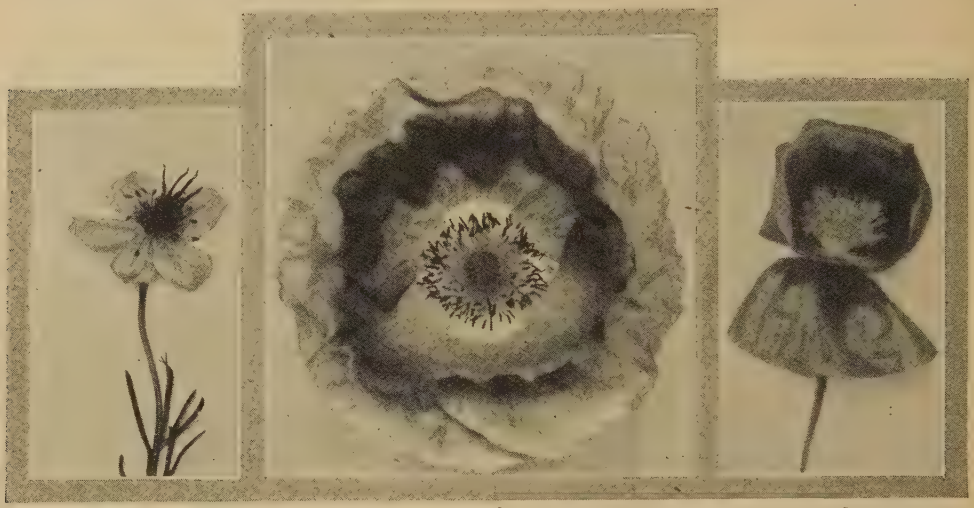
Her motherly instinct proved correct. The next day I witnessed the emerging of the young brood. She was head downwards in her burrow, and the young earwigs were crawling out around her body, all silvery white (page 414)—a detail which I had failed to notice in her first family. So that the earwig is silvery white on leaving the egg, and at each of its four moultings. These details, with those of the successive batches of parthenogenetic eggs, and its mud-laden feet, are, I think, facts new to entomological science. The next morning the mother insect was busy at her burrow, seeking food for a crowd of baby earwigs (page 414).

In the final photograph a specimen of the common earwig (*Forficula auricularia*) is displayed with wing-cases removed to show its expanded wings. In spite of the fact that it possesses such large and handsome wings, I am inclined to think that they are never once used for flight. It apparently presents an instance of an insect which is giving up flying and taking to crawling habits, in consequence of which its wings are gradually losing their function. Even when forced to expand its wings, it seems incapable of flight, and cannot replace them beneath its wing-covers without the assistance of its tail forceps.

The lesser earwig (*Labia minor*), an insect about half the size of the common species, is quite a good flyer, of daylight habits; while another British species occasionally met with (*Forficula lesnei*) is a wingless form. The common species is probably an intermediate type which was once a good flyer, but which is now in the process of changing to a wingless species.

The mother insect reared her third family quite successfully, and died of old age on September 19th. She was probably just over twelve months old, and may therefore be described as a comparatively long-lived insect, as insects go.

The Common Earwig (*Forficula auricularia*) with expanded wings—organs it never uses for flight (magnified).



1. 3. 2.

PERFECT AND COMPLETE FLOWERS—HERMAPHRODITE—IN WHICH ARE BOTH MALE AND FEMALE ELEMENTS, *i.e.* STAMENS AND SEED-CASE CONTAINING IMMATURE SEEDS.

1.—A Flower of the Buttercup type in which the seed-cases with their projecting stigmas are separate. 2.—A Poppy; here there is one central seed-case containing many seeds. 3.—Looking down on a Poppy as a bee does. In the centre is the big seed-case with its flat receptive top or stigma—a platform for insect visitors. Round it are ranged the stamens. Outside these is the scarlet petal dress, and at the back (unseen) are the green sepals.

# 5.—SEX AND TREE FLOWERS

By G. CLARKE NUTTALL, B.Sc.

With photographs by the Author

THE flower is the sum of the plant's arrangements for the reproduction of its kind. Whatever other rôle that flower may be supposed to play in Nature this is its primary one—the one for which it exists. Its beauty, its sweetness, its fragrance, all are there solely to further the production of posterity.

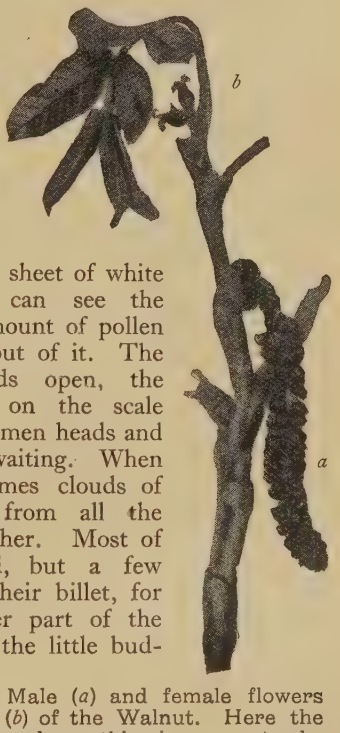
In both plants and animals good offspring is a matter of good and suitable breeding. How, then, does the plant act in this matter? Consider first a flower of the simplest construction—say, a buttercup. In the very centre are the immature seeds-to-be, each in its own distinct little seed-case with a receptive tip or stigma on top; this represents, of course, the female element of the flower. (In most flowers, however, the separate seed-cases are fused to make one which may have several chambers.) Around this stand numerous yellow stamens whose heads, or anthers, are boxes filled with pollen dust—the male element. These two are the essential organs of a flower. In a ring outside are ranged the golden burnished petals; these are the gay dress of the flower put on to beautify and attract, as are all gay dresses, and at the base of each is a tiny sac of nectar to add the lure of sweetness to the call of beauty. Behind the petals, outside all, is the green calyx cup which protects and holds the flower to-

Male (*a*) and female flowers (*b*) of the Hazel. The male will wither and fall; the female will become a little group of nuts.

gether. The main object of every plant is to get some of the male element—the pollen—transferred to the immature seeds in the seed-case so that it may fertilize and render them capable of developing into new plants. As a rule it is better that the pollen should not fertilize the stigma of its own flower; more vigorous seeds are produced if that pollen comes from another flower, perferably from a flower on another plant. It is to bring about this "cross-fertilization" that we find in plant life a realm of the most intricate mechanism, where often one part is so delicately balanced with another that deviation by a hair's breadth may put the whole out of gear. Even the angle at which a flower droops its head may be of vital importance in the interests of posterity.

More than a third of the flowering plants of the world are like the buttercup in having both stamens and seed-case, that is both male and female elements, in the same flower, being, in fact, "hermaphrodite" flowers. It is in these flowers that the most skilful scheming is necessary to prevent, or at any rate discourage, self-fertilization. In-and-in breeding practically always seems to tend to degeneracy, and an occasional cross, at least, is required to maintain the strain at its best level. It is here that the animal and the insect worlds, particularly the latter, are called in by means of colour, scent and honey to assist.

To deal in any comprehensive way with these schemes would fill many volumes; but we may turn to another large group of plants where the difficulty has been met in a very drastic way, and self-fertilization made impossible by the separation of the sexes in different flowers. Here we get male flowers on the one hand and female flowers on the other, and the attribute of sex stands out prominently in a way that it does not in the perfect and complete flower. Naturally it involves a great difference in the appearance of the two kinds of flowers. When a plant bears complete flowers all its flowers are alike, every buttercup, every poppy, every lime flower is as like as two pins to every other one of its own kind, but between the flowers of opposite sex of the same plant there is often not the slightest resemblance. Take the hazel, for example. What could be more unlike the drooping male catkins—"twisted gold," Whittier called them, "lambs' tails," say the children—than the tiny female flowers each with a fairy red brush on the top. The male catkin is built up of minute three-lobed scales set in spirals on a central axis, and may be two to three inches in length. Under each scale are four stamens so minute that they can hardly be seen; the head of each is filled with floury pollen. If one shakes a catkin over a sheet of white paper one can see the enormous amount of pollen that comes out of it. The stamen heads open, the pollen falls on the scale below the stamen heads and lies there waiting. When a breeze comes clouds of it fly out from all the catkins together. Most of it is wasted, but a few grains find their billet, for on the upper part of the branches are the little bud-like female flowers. These consist of overlapping




Male (*a*) and female flowers (*b*) of the Walnut. Here the male catkin is seen to be already withering; the female flowers become two "walnuts."

The little-known female flowers of the Oak. Later they develop into acorns.

scales; each of the inner ones embraces a seed-case with two long, stiff red threads on the top. As there are eight to twelve seed-cases, it follows that there are sixteen to two dozen red threads whose tops form the red brush that one sees pushing out to catch stray grains from the pollen cloud. The final result of fertilization is the little group of hazel nuts that we usually find together; the whole represents the product of that one tiny bud-like object of whose existence the majority of people are not even aware, though everyone knows the yellow catkins, "heralds of the spring."

Again, there are two kinds of flowers on the oak, male flowers and female flowers, though not one person in ten thousand has seen the latter, which later develop into the acorns that are everybody's friends. Indeed, if one saw them no one but a botanist would recognize them as "flowers," as obviously rendered by the photograph. Each is merely the most minute of seed-cases surrounded by bracts, and though, at first, six seeds start life in it, only one develops and produces the acorn. The male flowers are found on the numerous and very obvious irregular-looking catkins that appear in the early summer on the branches; these catkins are set in groups on the axis instead of in a continuous spiral as they are in the hazel.

The flowers of the beautiful walnut tree are also most interesting, and after the same fashion. The male catkins—the biggest and the handsomest we see in Great Britain—are as thick as a finger, and as long as one's hand. All down them in a close spiral winds the long line of male flowers, stamens set under big bracts to keep them dry. The female flowers can be seen

The male flowers of the Oak appear on the very irregular-looking catkins seen in early summer, being set in groups on the axis instead of in a continuous spiral as in the hazel.

in the photograph—little urn-like objects with two horns which are the stigma opened out to catch such grains of pollen dust as heaven may send their way on the wings of the wind. It is extraordinary in how many of the trees there is this division of the sexes and how wasteful a plan it often seems. In the above three cases there is a vast amount of pollen waste, for an enormous quantity has to be produced to ensure a few grains ultimately reaching their destination. One little assistance the trees give. Their flowers come either before their leaves or else before the leaves are fully formed; thus they do not block the rush of the pollen cloud through the branches.

In the beech the flowers, though still of two kinds and of opposite sexes, are rather differently planned. Here we have two sets of balls, one reddish, set upright on a short stalk and consisting of two female flowers with a projecting tuft of stigmas, and the other yellow, hanging below the female on longer stems and built up of minute bronze cups covered with silvery hairs, from which cups hang eight to twenty stamens. Here the tree adds to the precaution of separating the sexes, the further one of making the female flowers on any one tree mature before the males on that same tree, so that there is an excellent chance that they will be fertilized by pollen brought by the breeze from an adjacent tree before the pollen from their own tree can reach them.

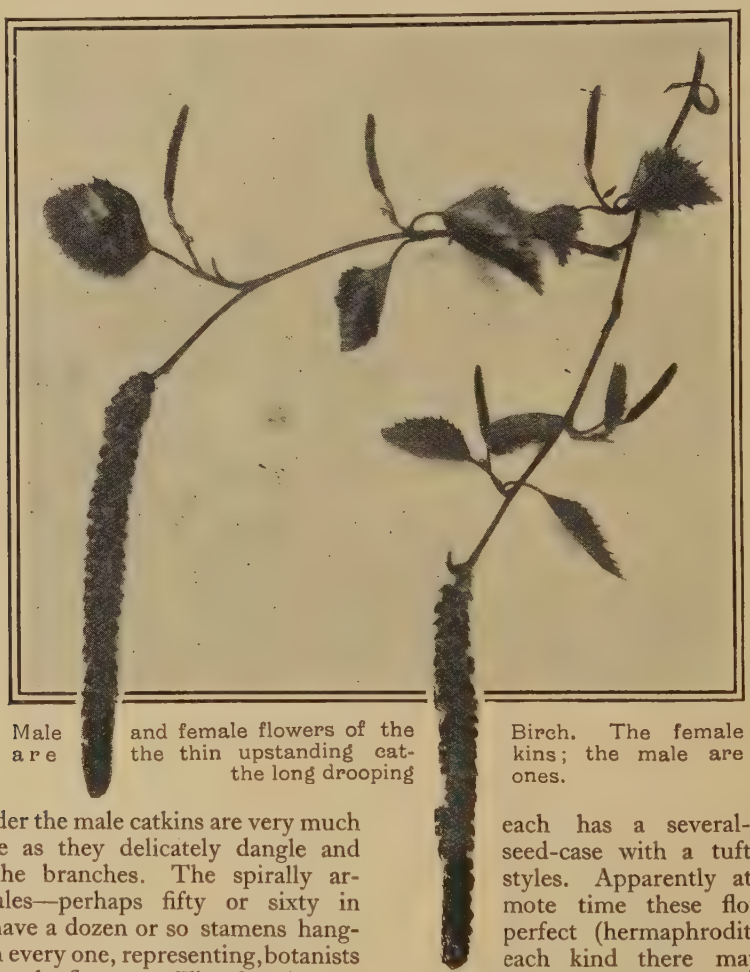
Male (lower) and female flowers (upper) of the Beech. The female become Beech nuts, the male fall off after dispersing their pollen.

The same plan obtains in the silver birch. The female flowers are ranged on little thin green columns, nearly an inch high, standing up stiffly on the branches. There are a number of overlapping scales, each of which encloses three female flowers—seed-cases topped with a couple of reddish thread-like stigmas which are thrust out like tongues when the right moment comes and, for two or three days, await pollen from another tree. In the meanwhile the much larger and longer male catkins are drooping from the branches, their stamens still unopened. Eventually they, too, are mature, and scatter their pollen which, cast to the wind, may fertilize in its turn female flowers on another tree or, possibly, also unlucky ones on its own tree.

Again, in those two comparatively little recognized trees, the hornbeam and the alder, there are also flowers of opposite sex growing side by side and quite distinct in appearance one from the other. In the hornbeam there are green female catkins at the ends of the branches looking rather as though they were buds that had been pulled out like a concertina. Each flower

upon them has a tiny scale at its base, which later grows into a sail, by means of which the ripe seed starts on its voyage of life. The male catkins, quaint and airy looking, since the flowers are not set very closely together, arise lower down the branches. The photograph gives a better idea than any verbal description of these two sets of flowers.

The sweet chestnut in flower looks as though it were covered with big yellow star-fish, for its male flowers are long plumes, eight or ten inches in length, which stand erect or radiate stiffly, and are feathery because the stamen heads all show. The female flowers are bunched into little round groups, often at the base of the male plumes, and



Male and female flowers of the Birch. The female are the thin upstanding catkins; the male the long drooping ones.

In the alder the male catkins are very much in evidence as they delicately dangle and sway on the branches. The spirally arranged scales—perhaps fifty or sixty in number—have a dozen or so stamens hanging beneath every one, representing, botanists say, three male flowers. The female catkins are minute things putting out still smaller tongues eager for pollen. As to their relative times of maturity the alder offers a puzzle. One eminent botanist gives the males priority of ripening, a second accords it to the females, while a third, equally eminent, asserts that both mature together ; probably the alder itself knows no rule whatever in the matter.

each has a several-chambered seed-case with a tuft of cream styles. Apparently at some remote time these flowers were perfect (hermaphrodite), for in each kind there may still be found rudiments of the sex in which they are now deficient.

The willows and poplars go a stage further in the differentiation of sex. So far, all the instances we have considered have both male and female flowers on the same tree. In the willows and poplars, as also in the yew among conifers, a tree is either wholly male or wholly female and bears either male or female flowers, but

Branch of Alder showing male (*a*) and female (*b*) flowers; also (*c*) the old fruits from the past year with their seed scattered.

Male (*a*) and female (*b*) flowers of the Hornbeam. The female green catkins which occur at the ends of the branches look rather as though they were buds that had been pulled out like a concertina; the male, quaint and airy-looking, since their flowers are not set very closely together, arise lower down the branches.

never both. It is as if the quality of sex had sunk more deeply into its nature. In this case, of course, it is impossible for immature seeds to be fertilized by any pollen except that from another individual, and the strain of these trees must necessarily be the product of continuous cross-fertilizations. Whether or no they are pre-eminently superior on this account is a matter for question. The palm (or goat) willow, whose male catkins are the beautiful "palm" of Eastertide, seems to bid for the aid of insects—bees and moths for choice—as it provides both honey and colour. The female catkins are much less attractive, being dull and green, and only beautiful when they turn into a mass of seeds crowned with silvery hairs. In fact, all the willows seem to tend this way, as they all produce honey which is no bait to the wind.

Female catkins (left) of the Black Poplar; red male catkins (right). These are always on different trees; hence one tree is male and another female—invariably.

In the poplars there is no question of insects, they are entirely wind-fertilized, though some of the catkins show up very attractively. Both male and female catkins, when fully grown, consist of a long drooping axis round which, arranged in spirals, are endless minute flowers more densely set together in the male than in the female. The male catkin of the common black poplar is really beautiful, for it becomes a brilliant crimson as it matures. And for this reason. Each of the tiny male flowers consists of a narrow scale which projects like an awning and is fringed at the edge; under this is a pale green scale to which are attached a number of stamens with bright red heads. At first they are hidden beneath the scale, but, as they grow, they push out their red heads beyond the awning, and as this happens in all the endless little flowers at the same

time, the whole catkin blushes a vivid red. On the female catkin each flower is just a sheathed green seed-case topped with a thick forked column so that the whole catkin looks greenish. In due course the red heads of the stamens open, the wind blows out their pollen in thick clouds, and, if the fates are kind, some of it reaches the female flowers on a female tree, but the odds are immensely against it. After fertilization the seed-cases dry and split, each half rolling back to disclose little black seeds to which are attached silvery hairs. And these seen altogether make the whole catkin look at this stage like a mass of white fluff. In the aspen, which is a species of poplar, the awning over the individual flowers has a fringe of long white hairs, so that both kinds of catkins have rather the appearance of furry caterpillars.

The differentiation of trees into male and female has somewhat curious results at times. Take the case of the steeple-like Lombardy poplar, for instance. It was a male tree only that was brought to England by Lord Rochford in 1758, so, as there could be no seed, propagation, therefore, had to be entirely by slips cut from it. Now cuttings always grow into trees of the same sex as that of the individual from which they are taken; hence it followed that all the subsequent Lombardy poplars were males. Female trees could only be secured as the result of a separate importation. Even so, it is strange that one very seldom finds female Lombardy poplars in this country. There is one near Kew Palace, but it is not characterized by the extreme slenderness that distinguishes the male form. It is, perhaps, because of this lack of distinction, and partly, too, because gardeners always oppose the planting of female poplars on account of their "messiness" in scattering their white cottony fruit that their importation has not been encouraged.

Male (*a*) and female (*b*) flowers of the Sweet (or Spanish) Chestnut. The male are the feathery upstanding catkins, the female are the little groups at the base of some of the male catkins.

It will have been apparent that, throughout all this class of unisexual flowers, there is a marked lack of colour, fragrance and sweetness. And this is natural, for these are solely forms of invitation and offers of payment to the insect world. In plants which trust to the impersonal wind for fertilization such blandishments would be only a senseless expenditure of energy.

*Photo: Richard Kearton, F.Z.S.*

Comparison of the Vole with the field-mouse is to the advantage of the latter, although there may not be much to chose between them for destructive power.

# 7.—A GENUINE VULGARIAN: THE VOLE

By H. W. SHEPHEARD-WALWYN, M.A., F.Z.S., F.E.S., F.R.Met. Soc., F.N.B.A., etc.

THE vole is a creature entirely devoid of personal charm. Surely the very name is enough to make one instinctively recoil! Who could possibly look for romance, for beauty, for attractiveness even, in the possessor of such a name as *vole?* To make his acquaintance in the flesh is by no means to court disillusionment. The dormouse one can fondle, the hare one can admire, the squirrel one can rave over, but for the vole one can feel nothing but suspicion and dislike. He has not even the manners of a gentleman, and the word "sportsman" does not occur in his vocabulary. True that, in the matter of destructive powers, there may not be much to chose between him and the field-mouse. The latter, however, is open and above-board in his actions—a sportsman from the tips of his whiskers to the end of his long sinuous tail. If he is out for mischief, one can see where he has been; the vole, on the other hand, never seems to lose an opportunity for hitting below the belt. One autumn I had occasion to plant some valuable young trees in a corner of the orchard; the following spring found them the picture of health and exuberance. Then, without any apparent cause, one of them drooped, withered, and died. Another soon followed in its wake, and presently I came out to find a third with

the fresh young leaves hanging limp and flabby from their stems. "Maybe they wasn't planted right," said the new gardener, glad of any opportunity to launch a back-hander at the reputation of his predecessor. "Rats!" quoth I, and, although it was only meant as an expletive, I was much nearer the truth than I had any idea of, for the rat is not such a very distant relation of—— But we must not precipitate our climax!

When yet another of the cherished saplings began to follow suit, I determined that the time was ripe for action. Pick and shovel were requisitioned—if only to show the sceptical gardener that the trees *had* been "planted right"—and a very few minutes' work disclosed a network of tiny burrows a foot or more below the surface of the ground. However, not even when a small, reddish brown animal presently broke cover and made a dash for safety did I think of connecting his presence with the deaths of my precious nurslings—but I knew the truth when we found the tender young roots nibbled and gnawed in truly heart-rending fashion!

It must not be supposed that the vole cannot also hit above the belt if the spirit should move him. There are other methods of murdering a delicate young tree than by devouring the root-fibres. It may not be generally known that the veins of a tree are in its bark. Mutilate the branches, gash the trunk, and the tree will recover; even slice off the bark wholesale—so long as a bare strip is left to carry the life-blood upwards. But the moment that a tree is completely "ringed," it may be considered as past praying for, and in regions where the voles are abundant serious havoc may be wrought in this way. I read recently of an extraordinary instance of the rapid increase of these pests, and of the injury which they sometimes perpetrate, which occurred about the middle of last century in the new plantations made by order of the Crown in Dean Forest and the New Forest. Shortly after the formation of these plantations, a sudden and rapid increase of voles took place in them, which threatened destruction to the whole of the young trees. Vast numbers of the creatures were killed, and it was found that they had eaten through the roots of five-year-old oaks and chestnuts, generally just below the surface of the ground. Hollies also, which were five or six feet high, were barked round the foot of the trunk, and in some instances the voles had

*Photo: Richard Kearton, F.Z.S.*

The Field Vole never seems to lose an opportunity of hitting below the belt; he is most destructive to the root-fibres of young trees.

*Photo: Frances Pitt.*

The Bank Vole differs chiefly from the common or Field Vole in the length of the tail, which is as long again as its little body.

The vole is a prolific animal, breeding three or four times a year, and producing five or six young at a birth. The nest, composed of leaves and moss, is tucked away amongst the roots of some thick tuft of grass, and I have sometimes found as many as a dozen nests within a few yards of meadow-land. Where adequate means of compassing their destruction is not resorted to, these creatures will, even nowadays, increase sometimes at a pace which is a serious menace to all forms of cultivation, especially after a mild winter. Indeed, a plague of voles assumed such proportions in the lowlands of Scotland a few years ago that all the higher pastures on the hills were destroyed. In normal cases, however, the balance of

climbed the trees and were seen devouring the bark on the upper branches. Various schemes were devised for their destruction; traps were set, poison laid down, and cats turned out, but the numbers of the voles increased by geometrical progression. At length someone came forward with a suggestion which was at first laughed to scorn. He had his way, however, and gangs of workmen were set to work in Dean Forest to dig a series of holes about twenty yards apart, eighteen or twenty inches in depth, and hollowed out much wider at the bottom than at the top. Thus it was almost impossible for the animals, when once in, to find their way out again. The result was that over thirty thousand voles were captured, and it was calculated that a much greater number were taken out of the holes by stoats and weasels, hawks and various other birds of prey.

An even more underhand method of hitting below the belt—and certainly more disastrous from the farmer's point of view—is the vole's habit of burrowing beneath the ground at sowing-time and devouring the seed-corn which has just been deposited in the furrows.

*Photo: Stanley Crook.*

The nest of the Field Vole, composed of leaves and moss, is usually tucked away in tufty grass; as many as a dozen nests may sometimes be found near together.

*Photo: Richard Kearton, F.Z.S.*

**THE FIELD VOLE.**

He is difficult to see because his silent, easy progress among the grass seldom betrays his presence. The red-brown colouring of the back also helps to render him inconspicuous in his natural surroundings, blending as it does with the earth and dead leaves.

Nature is to a great extent maintained without the aid of human agency, for there are many creatures that find the vole good eating; weasels, kestrels, and especially owls will gather in numbers about any particularly infested region. Damp pastures are the favourite breeding places of the field vole—or campagnol, as it is also named—and it is very interesting to watch them, when the dusk is falling, slithering and sliding snake-like amongst the grass. In many cases a highly trained eye is necessary to follow their movements with any degree of success, for they glide along so easily that the blades are scarcely stirred in their silent and almost imperceptible progress, while the red-brown colouring of their backs is so exactly similar to that of the earth and dead leaves littered around that you may stand and stare at one for some minutes before realizing what it is.

The second of the three British species is known as the bank vole, or bank campagnol, but its characteristics are so similar to those of the common or field vole that it would hardly be worth while to dwell upon it at any length. The chief difference lies in the length of the tail, which in the case of the latter is so ridiculously stubby and out of proportion to the rest of the body as almost to give rise to the impression that the owner had met with an accident, and had a piece cut off. Both species measure from five to six inches in length, the ears are rounded and very small, the chest and abdomen being much lighter in colour than the back, and the tail of the bank vole accounts for fully half of its total length. The field vole, with his broad, blunt face, sunken eyes and ears, and general sheepish expression, presents a vivid contrast to the sprightly little field-mouse, with which he should not be confounded. The latter is not a Vole at all, but a genuine mouse. It is a curious fact that the genus vole is quite unknown in Ireland—but no doubt Ireland has enough trouble without it!

*Photo: Frances Ltd.*

A highly trained eye is necessary to follow the movements of Voles, for they glide along so easily that the blades of grass are scarcely stirred in their silent progress.

# The FAIRYLAND of NATURE

## Pages for the Children by OLIVE HOCKIN

*Photo: Alfred Taylor.*

"Like prim little girls at school the seven blue Kingfishers sat ranged along the branch."

## V.—The Dragon and the Seven Blue Maidens.

"TOPSY!" said Boodles meditatively. "If you were just as big as my thumb, I know where there is a great fierce dragon who would carry you off to his cave, and then I'd be St. George in golden armour, and come and rescue you!"

"Nonsense!" said his matter-of-fact sister. "Dragons were all killed off hundreds of years ago. What stories you do make up, Boodles!"

"'Tisn't stories!" said Boodles. "I do know where there's a monstrous dragon! At least he *would* be monstrous if only we were small enough! He's got a long scaly body and four legs with claws and a long twisty, scaly tail!"

"Oh Boodles!" joined in Popsi, always agog for adventure. "Do tell me where he is! Can't we go and find him?"

"Well," said Boodles. "We shall have to make ourselves very, very small, and crawl on hands and knees through the tangly grass till we come to the river, and then perhaps we'll see him looking out of his cave!"

"Come on, Topsy!" cried Popsi. "Do let's go and see!"

Topsy, though she did not believe in fairy tales, was curious enough to join in the expedition, and away they all went, down through the orchard and over the meadow to the marshy lands by the river.

What a tangle of grass and reeds and thistles they had to crawl through! The feathery wild

parsley grew so tall that it made a white lace-work over their heads. In the reeds a warbler was trilling away to his little wife on her nest, while on a bush near by a chaffinch was singing over and over again his descending run of notes, rounding them off each time with a queer, up-and-down *"Squee-chu!"* which sounded as if he were very well pleased with his performance.

Photo: A. M. C. Nicholl.

The Chaffinch always seems so pleased with his little song that he sings it over and over again—*"What-a-funny-thing-o-squee-chu!"*

Suddenly, as they crept on, a glint of blue light flashed out of the willow tree, scored its way from right to left, and vanished down the river.

"Oh!" gasped Popsi and Boodles.

"Oh!" cried Topsy. "It must have been a kingfisher! Let's see if we can find his nest!"

"What sort of a nest does a kingfisher make?" asked Boodles.

"I know!" said Popsi. "Spring was telling me last time I saw her. If it can't find a nice hole ready-made it digs one itself in the river bank—ever so far in, so that you can't reach the eggs however much you stretch!"

"And then," continued Topsy, "it makes the most uncomfortable nest you can imagine! No cosy little home lined with feathers, but a horrid mass of fish bones—and bones it has already swallowed too! It rolls them up in its inside and then spits them up, and then sits on them to shape the nest!"

"Well, never mind the kingfisher!" said Popsi. "Do let's get on and find the dragon!"

"He lives over here," said Boodles, leading them through the reeds to a shallow pool that lay back from the river. Then round a corner, suddenly, they came upon a little scene that made them all stop and hold their breath.

Over the dark pool of the backwater, a low branch hung out from the bank. And on the branch were sitting, just as you see them in the picture, seven wee birds! Seven small round bodies, seven big

*Photo: Henry Irving.*

IN THE MARSHLANDS BY THE RIVER.

"The feathery wild parsley grew so tall that it made a white lace-work over their heads."

heads and seven long, strong beaks, and each one clad in the brightest of bright blue frocks. All in a row they sat, like good little girls at school.

"Why!" gasped Boodles, who must always make up stories about everything he sees. "Those are the seven captive maidens—and there is the dragon who captured them! Look, Topsy, do you see?"

Popsi and Topsy crept down till they could see where Boodles was pointing. And to be sure—it was just as he said!

On the shore at the edge of the shallow water was a gruesome dragon indeed! He had a long golden-brown body with an orange breast spotted with black, a great head with protruding eyes and enormous mouth, four crooked legs with claws, and a twisty, scaly tail which quavered to and fro!

"Why!" said Topsy. "It's just a newt! And newts don't eat little blue kingfishers — they eat tadpoles."

"I tell you it's a dragon——" began Boodles, "if you can only think yourself small enough——"

But Popsi didn't care whether it was a newt or lizard or a dragon—or what anything was called. To her it was just one more thing to play with, and away she went to try and catch it.

"Come back, Popsi! You can't cross there!" cried Topsy.

But it was too late to stop her. Crash into an unseen puddle she went—off scuttled the dragon, and away flew the seven little kingfishers. And a muddy, bedraggled little girl was pulled back out of the reeds and taken off home to change.

But the chaffinch, who had been watching all the time, just went on singing — *"What-a-funny-thing-o-squee-chu! What-a-funny-thing-o-squee-chu!"* And he flew after them calling again and again the same little refrain, so that to this day Popsi never hears him without thinking of the dragon and the seven blue maidens and her tumble in the muddy backwater.

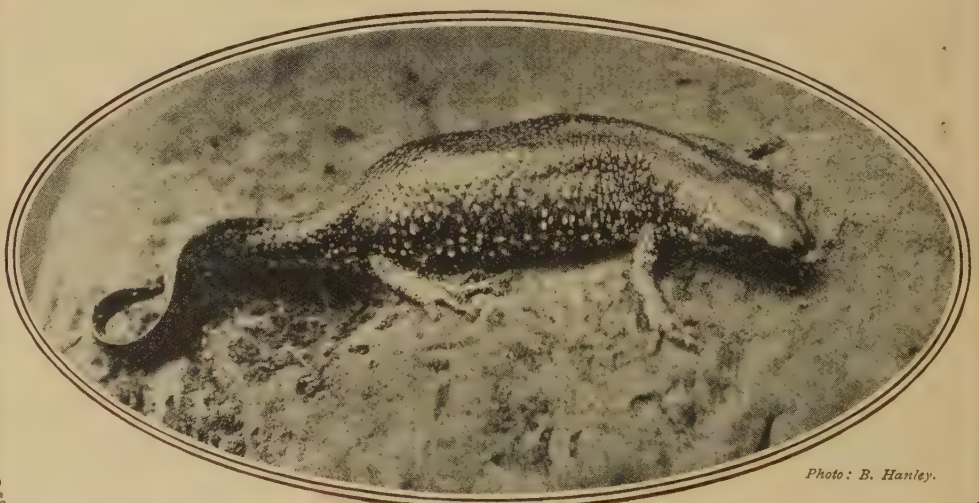
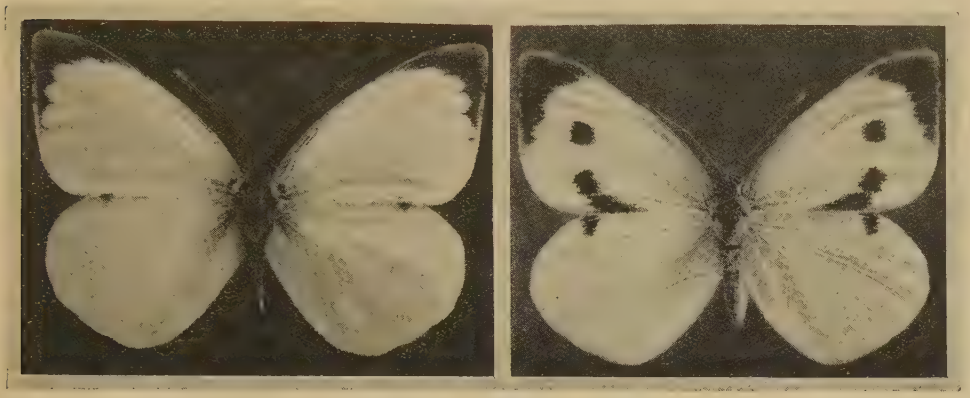


*Photo: B. Hanley.*

At the edge of the water, with orange breast spotted with black, four crooked legs with claws and a long, twisty, scaly tail, there sat a gruesome Dragon.



Male (left) and female (right) of the Large White Cabbage Butterfly (*Pieris brassicæ*). The sexes may be readily distinguished by the presence or absence of spots on the fore-wings. (× 1.)

# 12.—THE CABBAGE WHITE BUTTERFLY

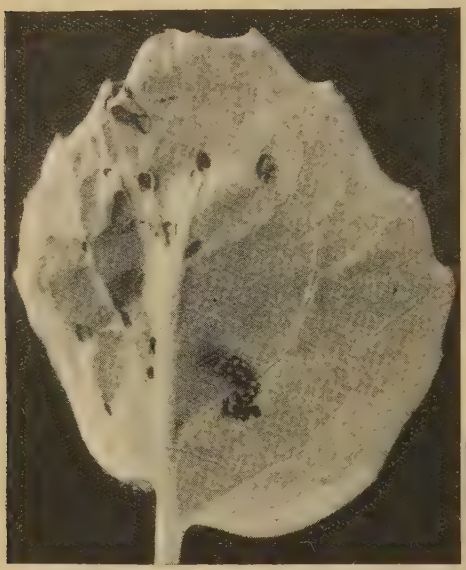
By K. G. BLAIR, B.Sc., F.E.S.

With photographs by Hugh Main, B.Sc., F.E.S.

AMONGST the large number of insect species that do not materially affect mankind, and whose habits pass more or less unnoticed by him, some few draw his attention upon themselves by interfering with his well-being and with his carefully laid plans. A few of these attack his person, but many more attack his food produce, some when dried or stored, but more in the form of the growing crops.

We in this country are probably rather favourably situated as regards the paucity of such insect pests compared with most parts of the world where agriculture flourishes, but even in Britain certain of them contrive to make their presence felt. Perhaps two of the best known are the large and small cabbage white butterflies, whose depredations upon plants of the cabbage tribe are only too familiar to anyone who attempts to grow these vegetables. Even so, it is astonishing how few horticulturists realize the connexion between the pretty white butterflies and the perforated and ruined condition of their cabbages that ensues. Popular education in such matters has, it is true, made considerable strides within the last few years, and with the immensely increased interest in the production of vegetables, popular attention was inevitably drawn to the hostile influences at work upon them.

If a number of white butterflies from the garden be collected it will probably be found that they can readily be sorted into two sizes, a few being considerably larger than the majority. These larger ones, and probably most of the smaller ones, will be found to have the undersides of the lower wings, i.e. the surface, exposed when the wings are folded together over the back as in the normal position of rest, more or less uniformly creamy yellow, while some of the smaller ones have them distinctly marked with broad blackish green lines. These latter are the green-veined white, and are more partial to horse-radish and certain wild plants of the cabbage tribe, such as jack-by-the-hedge, than to our cabbages. Those with



Batch of eggs of the Large White Butterfly deposited on a cabbage leaf. The eggs may number from twenty to thirty in each batch; in the Small White Butterfly only one egg is laid at a time. (× 2.)

the plain undersides are respectively the large and small cabbage whites, and both are serious garden pests. If, now, the upper side of the wings be examined it will be seen that all have a conspicuous black tip to the fore-wings, while some have black spots on the central area of the wing as well. Those with no such spots, or only a single small one about the middle of the wing, are the males, while those with this central spot comparatively large and a similar one just below it near the hinder edge of the wing are the females, so that these species are said to be "sexually dimorphic," which means that the two sexes have different colour patterns.

If they be watched for a while as they flit over the garden it will be noticed that some just fly rapidly across without taking any particular notice of the plants, some, on the other hand, will flit from flower to flower, stopping here and there to suck up the nectar by means of their long slender "tongue," which when not in use is coiled up like a watch-spring on the underside of the head. Others again fly rather slowly and low down, paying particular attention to cabbages, cauliflowers and such like (the garden nasturtium *Tropæolum* is another favourite), and taking no notice of the flowers. These we shall see have the two spots on each upper wing, and are the females busy depositing their eggs. If we watch one carefully when she alights we may see her apparently dabbing the leaf with the end of her body, and if the leaf be examined when she has gone, we may see the egg or eggs she has left, usually on the underside of the leaf. And here we may notice a peculiar difference of habit between the two species. The large white leaves a batch of perhaps twenty or thirty eggs all close together,

The skittle-shaped eggs of the Large White Butterfly may be seen with the unaided eye, but by the use of the microscope a series of about fifteen strong ribs connected by a system of fine transverse ribs will be revealed. (× 20.)

whereas the small white leaves only one egg at a time.

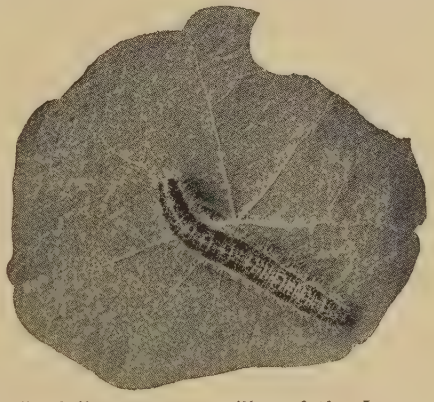
Let us examine the eggs more closely. Even with the unaided eye they will be seen to be somewhat skittle-shaped, or like one of the bottles in which milk is distributed, coming to a blunt point at the upper end ; but instead of having a smooth rounded sur-

A group of young caterpillars of the Large White Butterfly on the underside of a nasturtium leaf. Each has a conspicuous shining black head, but the rest of the body is of a greenish hue. (× 2.)

face, by the aid of a lens it can be seen that they have about 15 strong ribs running from top to base, these ribs being connected by a large number of very fine transverse ribs. Their colour is at first lemon yellow, but after some days they become greyish, and a little later the young caterpillars nibble a hole in the side, through which they crawl out. They at once proceed to fortify themselves by devouring their empty eggshells. The little caterpillars of the large white have a conspicuous shining black head, the rest of the body being greenish. They usually remain huddled together and feed at first on the underside of the leaf, though frequently nibbling right through. When they reach the limit of distensibility of their skin they cease feeding, rest quietly for a day or two, when the old skin splits down the back and is shuffled off, the caterpillar emerging with a new one a size larger. This operation is frequently called a " moult," and a newly moulted caterpillar may always be recognized by its fresh unfaded colours, and by the larger size of the head compared with the rest of the body.

For the first two or three moults their colours and habits remain much the same, but after the last one the black head becomes replaced by a bluish-grey one, the body is variegated with green and yellow and has numerous black spots all over the surface, rendering the caterpillar very conspicuous. To increase this effect the brood, which has hitherto retained its gregarious habit, now breaks up and the caterpillars sprawl about all over the cabbage and on the upper surface of the leaves, and the greater part of that cabbage plant soon becomes reduced to little more than a tracery of leaf-veins,

Very different is the habit of the larva of the small white ; each one remains isolated, a soft green in colour with a green head, the whole body having almost a velvety appearance. It remains motionless, extended along one of the veins on the underside of the leaf, and succeeds very well in assuming a practical invisibility. As it grows older it penetrates more to the heart of the cabbage,



The full-grown caterpillar of the Large White Butterfly is a very conspicuous object, with its variegated green and yellow body profusely sprinkled with black spots. (× 1.)

and is most readily found by searching the upper side of the midrib of the younger leaves, when its presence is revealed by the damaged leaves and the accumulated frass.

What can be the reason of this very

strong contrast in the habits and appearance of the caterpillars of two butterflies so closely allied, and of such similar appearance? It is probable that there is something in the larvæ of the large white that gives them a nasty taste. At any rate, it is known that the body fluid of the caterpillar has a very unpleasant smell when crushed, and has a certain irritating action upon the skin which would make them a very unpleasant mouthful to a bird, while the caterpillar of the small white apparently has no such effect. Experiments devised to test this theory have not proved uniformly successful; in some cases it has been found that fowls will devour both species, while in others it has been found that the caterpillars of the large white are rejected. We have here, then, a clue to the difference in behaviour between the two species; the small white seems to realize that its safety depends on concealment, and that its colour renders it practically invisible on a leaf of the same colour, whereas the large white appears almost as if it knows that no bird will touch it, and that the more fully it is visible the more readily will it be recognized as nasty, and so left alone. In fact, these two species afford very good examples of the types of coloration known to scientists as "cryptic," or "protective," i.e. conducive to concealment, and "warning," i.e. advertising to possible enemies that their wearers are best left alone.

When the caterpillars have reached their full size they usually leave the plants upon which they have fed and wander off in search of a suitable situation in which to undergo their further changes. A neighbouring fence or wall, if available, is frequently chosen for this purpose, and the caterpillar will frequently cover a considerable distance before it is satisfied. Opposite the writer's house are some allotments separated from the road by a wire fence, and every winter numbers of chrysalises of both the large and small whites are found not only on the garden fence, but even on the house walls and about the door and window frames, at least fifty feet from the nearest possible food supply. Probably if no such surface can be found, some tree-trunk, stick, or firm stem will be utilized for the purpose, though the pupæ seldom seem to be found in such places.

Pupation of the Large White Butterfly. A B, the state of rest after making the tail- and middle-body pads. (Note that in B the larva has slightly shrunk in length). C, the skin splits down the middle of the back behind the head, and a moist-looking body seems to bulge out of the slit. In D, E, F, G, the process of emergence from the old caterpillar skin is continued, until the chrysalis is completed and the second period of rest is reached.

Having selected a suitable spot the caterpillar then proceeds to spin a carpet of silk, forming a small particularly dense pad just at its tail end, and another smaller pad on each side of it about the middle of its body. Next it connects these two side pads with one another by means of a girdle of silk across its back. It then settles itself, securing a firm grip on the silken carpet by means of the minute hooks with which its feet are armed, and remains motionless for two or three days. During this time it shrinks slightly in length, and loses all power of locomotion, so that if disturbed the sole movement of which it is capable is a

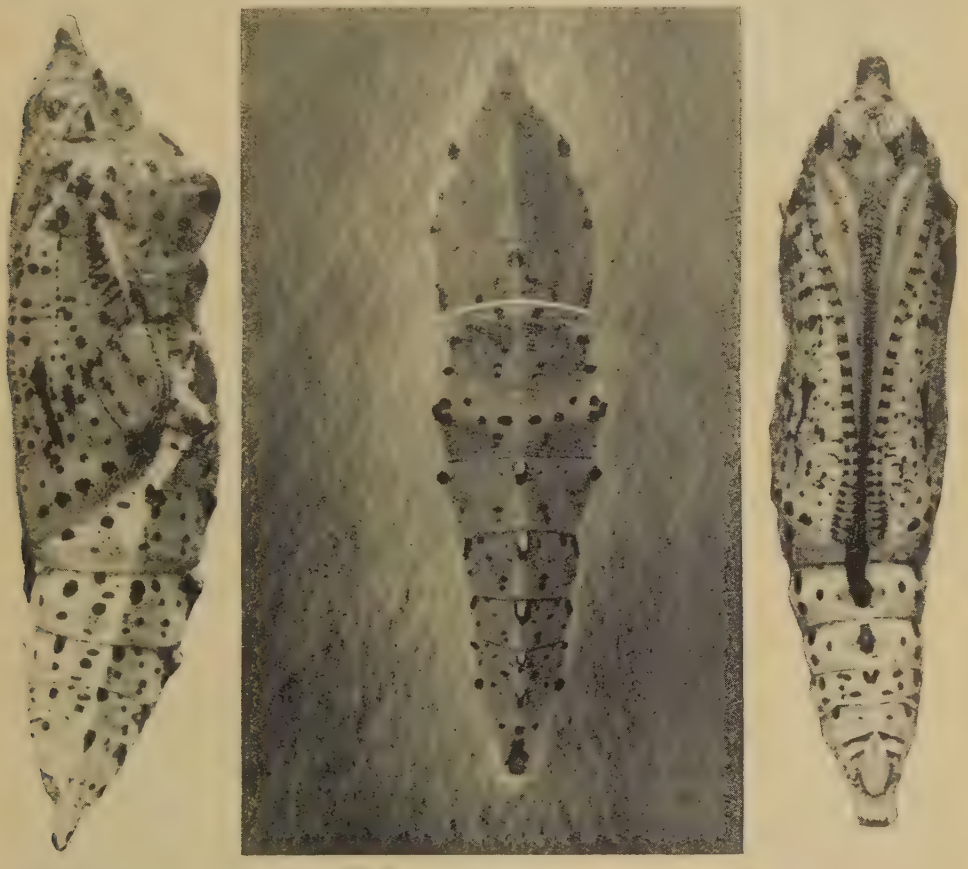
SILVER-WASHED FRITILLARY BUTTERFLIES.

(The upper one is the female.)

*From an Autochrome by A. Harold Baston.*

violent bending of its body from side to side. (This state shown on p. 436, A and B.)

The next thing that happens is that the skin splits down the middle of the back for the first three or four segments behind the head, and a pale greenish, moist-

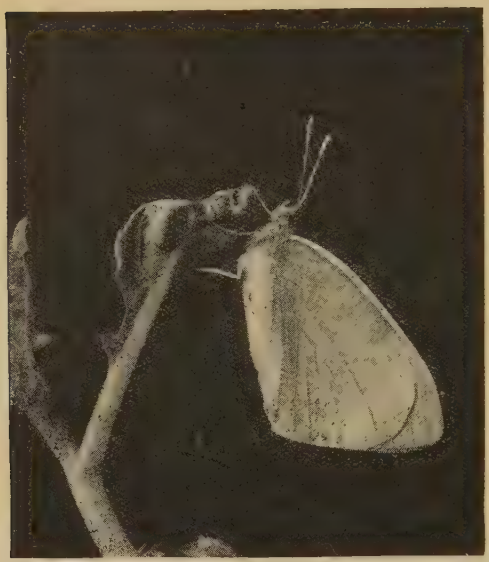


Chrysalis of the Large White Butterfly, showing (left and right) the lateral and ventral surfaces and (centre) the dorsal surface. (Left, right, × 8; centre, × 6.)

looking body seems to bulge out of the slit. Gradually it emerges more and more, aided from time to time by wriggling motions of the body, and the old skin is wrinkled up, accumulating towards the rear end of the caterpillar, and at first carrying the girdle with it, until finally it encloses only the extreme tail of the newly emerged chrysalis (p. 436). This is then withdrawn from the skin and slid over it and the point inserted in the pad. A few violent kicks with the tail, and the old skin is jerked away altogether; the minute hooks on the tail of the chrysalis are worked securely into the silk pad constructed by the larva, and once more the insect becomes motionless.

At first the chrysalis is soft, round in section, and covered by a glistening fluid secretion of the skin, but the latter soon hardens on exposure to air, forming a firm shell, and at the same time certain ridges or crests make their appearance, rising here and there into more or less sharp points that give the chrysalis an angular appearance very different from that of the caterpillar.

With the disclosure of the chrysalis we get the first suggestion of the appearance of the limbs of the perfect butterfly. If we look at the ventral surface we see immediately behind the point on the front of the head the sheaths of the two



Large White Butterfly which has just emerged from the chrysalis. At first it is a sorry looking object, with the fine silky clothing matted with wet; but here the wings have become fully extended, though still limp and soft. (× 1.)

large compound eyes of the butterfly ; behind these in the middle line are the tongue sheaths, stretching away beyond all the other appendages to form a little point beyond the middle of the body ; outside these are the sheaths of the first two pairs of legs ; outside these again, from the back of the eyes, and gradually approaching one another almost to the tip of the tongue sheaths, are the black and pale ringed sheaths of the antennæ, and lastly the broader sheaths of the fore-wings.

When the caterpillar skin is first shed these appendages are found to be free and separately movable with a fine instrument, but as the fluid secretion hardens they are all firmly glued down until finally the first two ring-joints of the body beyond the wing tips are all that remain capable of movement ; in other words, the chrysalis can wag its tail and that is all.

After some time, which varies according to the period of the year at which the chrysalis is formed, certain colour changes may be perceived to be taking place in the pupæ. The wing cases assume an ivory-white tint on which greyish cloudings are visible ; these cloudings are the black markings of the butterfly showing through the nearly transparent skin of the chrysalis, and bear no relation to the black spots with which the latter is ornamented ; at the same time the body becomes somewhat silvery grey. In the case of pupæ formed in early summer, about June or July, these changes occur in a fortnight or three weeks, and the butterfly appears very shortly after ; but in the case of chrysalides formed in autumn they are delayed till about the following April, for the cabbage white produces two, or even three, broods in the course of the summer. The caterpillars that are found in the autumn are the progeny of an earlier emergence of the butterfly.

When the butterfly is ready to come out, by muscular exertion within the chrysalis, the skin is split down the middle line of the back, and the insect begins to force its way out. But the skin of the chrysalis is firm, and as it were formed of armour-plates,

Small White Butterfly (*Pieris rapæ*) at rest, displaying the more or less uniformly creamy-white of the undersides of the lower wings. (× 1.)

which cannot shrivel and crumple up as does the skin of the caterpillar when it moults, so that the butterfly has to force its way out of the split between the plates. This is made easier by the head plates, together with that part of the sheath which encloses the legs and antennæ being pushed off forwards at the same time, so that the butterfly can soon pull its legs free and use them to grip the surface in front of it. Having secured a firm foothold it is a comparatively easy matter for it to pull the rest of its body free from the chrysalis skin which remains securely held in its place. It is thus evident why, if the chrysalis has been removed from its place of attachment, it frequently happens that the butterfly is unable to pull itself free from the pupal skin and perishes in the act of emerging.

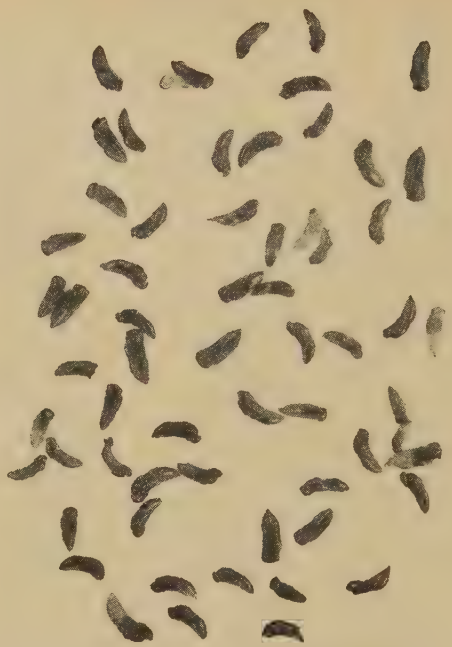
Caterpillar of the Green-veined White Butterfly. (× 1.)

Chrysalis of the Green-veined White Butterfly with the markings of the Butterfly showing through. (× 1.)

Green-veined White Butterfly (*Pieris napi*) which has just emerged from the chrysalis. It is more partial to horse-radish than to the cabbage. (× 1.)

At first the newly emerged butterfly is a sorry looking object, the fine silky clothing of the body matted with wet, the body itself heavy and flabby, and the wings no bigger than the wing-pads of the chrysalis. It quickly finds a secure foothold and comes to rest with the heavy body hanging downwards. Soon the base of the wings begins to swell and buckle up, this buckling slowly, almost imperceptibly, encroaching upon the wing area. At the same time the body may be seen to expand and contract with an almost regular rhythm as though the insect were taking a series of deep breaths. In reality this muscular contraction of the body is forcing some of its superfluous fluid contents into the veins that permeate the wings, causing these to straighten out and stiffen,

Larvæ of parasites infesting the chysalides of the Large White Butterfly. (× 2.)



The Large White Butterfly, despite its distastefulness, has many enemies. These are pupæ of some of its parasites taken from the chrysalis of the Butterfly. (× 3.)

Parasites which have just emerged from the chrysalides of the Small White Butterfly. (× 3.)

and so expand the membranes between them. When the process is completed the wings have attained their full size and are quite flat, but being still limp must be allowed to hang downwards until sufficiently hard and dry to be of use for flight.

It soon becomes evident that if all the eggs laid by a female large white were to reach maturity, the numbers of the butterflies would show a regular and rapid increase; but the fact is the numbers of the butterflies remain approximately constant from year to year. From this we conclude that there must be some check upon their undue increase. If a few of the caterpillars be kept under observation, it will

Larva and female pupæ of the Ichneumon Fly parasite—*Pimpla instigator*—taken from the chrysalides of Large White Butterflies. (× 2.)

Male pupæ of *Pimpla instigator*. The grub of this parasite is so large that a caterpillar can only nourish one of them. (× 3.)

almost certainly be found that a number of them fail to complete the change. They spin their silken carpet, and are apparently quite ready, when a number of little white grubs bore their way through from inside the caterpillar, and very soon spin each one a little cocoon round itself, so that we find instead of the chrysalis the shrivelled remains of the caterpillar surrounded by a number of these golden yellow silken cocoons. From each of the attempt to knock its small tormentor away. Frequently it is successful, but the fly picks herself up and quickly returns to the attack.

This account does not agree with that given by Fabre in " The Life of the Caterpillar." He relates his failure to induce the parasites to oviposit in either the old or young caterpillars, though they readily did so in the eggs of the butterfly. The pro-

1. Pupæ of the Ichneumon Fly—*Pimpla instigator*—in chrysalides of the Small White Butterfly. 2. Larva of *Pimpla instigator* in the chrysalis of the Large White Butterfly. 3. The parasite *Pimpla instigator* emerging from pupa skin. 4. The perfect female *Pimpla instigator*, showing the long ovipositor. 5. The perfect male—*Pimpla instigator*. (× 2.)

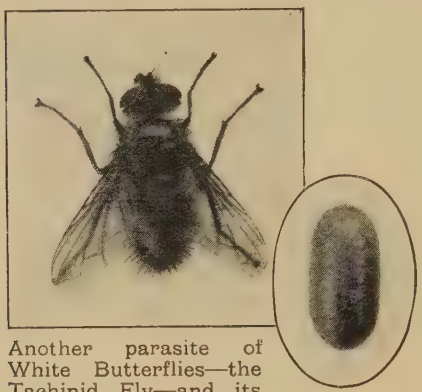
these in due time emerges a small black fly known to science as *Microgaster glomeratus*.

Against this minute winged terror the distastefulness of the caterpillar is of no avail. The mother fly cautiously approaches the nearly full-grown caterpillar, taps it with her antennæ, probably to learn whether it has been already attacked by others of her species, then, if found to be satisfactory, jumps on it and endeavours to lay an egg with her sting-like ovipositor in the body of the caterpillar. The latter seems to be aware of its danger, and on the approach of the fly becomes uneasy, swaying its fore-part from side to side, and when the fly alights on its body, flings back its head in

cedure above related, though not observed by the writer, is well vouched for, and it is not easy to account for the discrepancy. As Fabre reared his flies from the well-known cocoons it would not appear to be a case of mistaken identity on his part, and neither can one doubt the accuracy of the observations here recorded. A possibility remains that the parasites of the winter generation of cocoons and those of the summer generation may not have exactly the same habits, the former ovipositing in the eggs of the butterfly, the latter in the caterpillars.

Though probably the commonest parasite of the large white and serving as the most effective check upon its undue increase, the

microgaster is by no means its only enemy. Other still more minute flies, belonging to the family *Chalcidæ*, lay their eggs in the eggs of the butterfly and destroy it in this stage,



Another parasite of White Butterflies—the Tachinid Fly—and its puparium. (× 3).

while others of the same family lay their eggs in the chrysalis itself. The photograph on p. 440 shows a chrysalis of the butterfly opened to exhibit the progeny of one of these, which entirely fill the chrysalis. These grubs do not leave the "host" to pupate, but undergo their development within the chrysalis case. They are thus already well protected, and so are able to dispense with the cocoons spun by the microgaster. The photograph on p. 440 depicts the flies just emerged, and shows the single hole by way of which the whole brood made its exit.

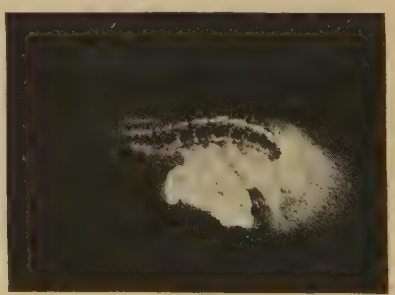
Yet another parasite is the ichneumon fly, *Pimpla instigator*. In this case the grub of the parasite is so large that a caterpillar can only nourish one of them. The photographs illustrate its metamorphosis within the chrysalis from the full-grown larva, the pupa, and finally the perfect flies. It will be noted that the long ovipositor of the female fly is already present in the pupa, though since there is not room for its full extension it is curled over the back.

All the parasites so far mentioned belong to one order of insects, the *Hymenoptera*, to which the bees and wasps belong, but the tale is not yet complete. The photograph above shows yet another parasite belonging to the two-winged flies or *Diptera*, which includes the house-flies and blue-bottles.

It must not be supposed, however, that these numerous parasites have things altogether their own way. To some of them, at least, a kind of Gilbertian justice is meted out by parasites, relatives of their own, which treat them in turn in a similar fashion; reminding us of the lines:

*"The larger fleas have little fleas upon their backs to bite 'em;*
*These little fleas have lesser fleas, and so ad infinitum."*

Not only is the large white subject to the attacks of all these (and other) insect enemies, but even our climate does not seem to be well suited to it, and many of the chrysalises that enter upon winter apparently quite healthy fail to survive it. Indeed, this butterfly, like certain others such as the clouded yellow, the painted lady and the red admiral, have their headquarters in more southerly climes than our own, and the British Isles are situated near the limit of their geographical range. All these butterflies have a strong migratory instinct, and every spring varying numbers come over to our shores from the Continent. During the summer—during a normal summer that is—all is well, and they increase and multiply as far as the different parasites allow, but the winters bring disaster, and were it not for the renewal of the race by immigration in the spring it is probable that each of those named would very soon become extinct in Britain. That the large white comes within this category has, indeed, only of recent years been suspected, and it may well be that in the milder climate of the southern and western parts



Caterpillar of the Large White Butterfly destroyed by *Microgaster glomeratus*. The grubs of the parasite, after boring their way out, have spun their cocoons beside the dying caterpillar.

of our islands the species may be able to maintain itself, and thence by annual migration maintain a fluctuating and scanty supply in other areas.

# 13.—A COURTSHIP EPISODE OF THE SMALL TORTOISESHELL BUTTERFLY

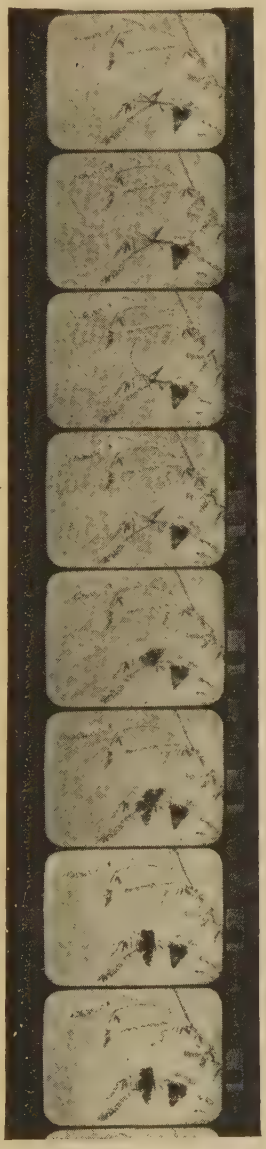
By JOHN J. WARD, F.E.S.

Illustrated with Kinema photographs by the Author

IN the present state of things one can scarcely conceive the wondrous possibilities of development and revelation in nature study which may be forthcoming from the kinema-camera in the near future; at the moment the whole thing is in a state of merest infancy. It is details which count in nature study, and every naturalist photographer who does original work can, from his own experience, record aspects of living things which he alone has observed. Perhaps he has carefully worked out the complex life story of an insect, and incidentally discovered the life histories of some of that insect's parasites, or natural enemies, and, possessed of that knowledge, he can apply his camera and produce a film which will record permanently, for all time, those details and actions he has observed.

It does not follow that the details recorded need be of a dull, or strictly scientific, character. Some of the most charming pictures of wild creatures may be made which illustrate their curious and interesting ways, and often reveal to us the fact that they bear many points in common with ourselves.

So far as I know, no photographer has yet applied the moving-film camera to recording details of incidents in the lives of wild British butterflies. There is probably a good and sufficient reason for this neglect, since these insects present enormous difficulties for the ordinary camera when they are photographed in the living state, and still greater ones for the kinema-camera. Indeed, living insect photography probably represents the most difficult of all forms of moving-picture photography. It is possible to make an appointment with a bird, or an animal, knowing where it will be more or less continually during the period of its nesting or breeding season, but a live butterfly presents a much more difficult problem, for it has no nesting time, and may not be in the same place for more than a few seconds together.

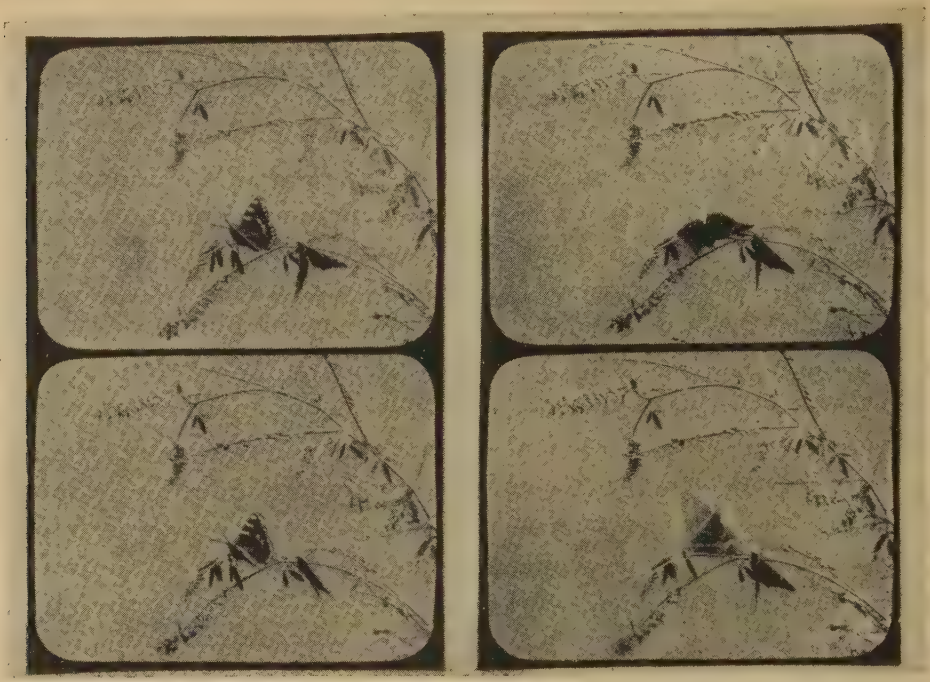


The actual size of the photographs as taken.

Nevertheless, if a moving-picture is to be made of its activities, it has to be approached with the comparatively clumsy kinema-camera, and it is essential that the focusing should be of the most accurate character, as the film area occupied by the whole scene photographed is barely an inch wide and only three-quarters of an inch in depth. The butterflies in such a scene are necessarily very small—as may be seen from the reproduction of film strip—and are not at all easy to see when focusing, yet, to get successful results, it is necessary that even their antennæ, or feelers, should be sharply defined.

1. On the upper stem is shown a male Small Tortoiseshell Butterfly with amorous intentions towards the female on the lower stem. An interval of $\frac{1}{16}$th sec. occurred between the two exposures. 2. The male decides to make an advance. He turned rapidly and 3. gracefully alighted on the stem by her side; his capricious lady reciprocated immediately her lover's movement. 4. So nervous was the male that he lost his balance on the stem, and twirled round and round it. During this contre-temps the female quietly surveyed him.

5. At last, gaining his balance, he put on a bolder front, and for a time all seemed well. 6. Then arose a little difference, which developed into a decided "tiff," and— 7. —was followed by a distinct display of temper. The lower photograph shows that she regards his suit as hopeless, for— 8. —she turned away from him, while the movements of his wings indicated his continued pleading.



9. 10.

9. His drooped wings show that his appeal had failed entirely. 10. Without hesitation, she spread her wings for flight, and left him.

Since this aspect of photography has apparently been left untouched, I have attempted to fill in the gap, and after spending many days and weeks together for the past two summers waiting for and stalking butterflies of various species, I am enabled to offer the readers of this publication a series of photographs from one of my films, which I think I may claim are unique and something entirely new to nature photography, depicting a rather unfortunate love adventure of a male small tortoiseshell butterfly.

It is during the many hours of waiting opportunities to use his camera that the nature photographer often has revealed to him some of Nature's most intimate episodes. When all is still one often observes wonderful and unexpected incidents, and, while stalking my butterfly friends, I was frequently charmed by their courtship movements, and also much impressed by the fact that they closely resembled those of the human kind. I have attempted to portray that attribute in this series of photographs.

It should be noted that in each case where the photographs are joined, the interval of time between them is one-sixteenth second, but, of course, between each pair of pictures some hundreds of photographs are omitted.

Look now at the pair of pictures shown in No. 1. Above is seen a male small tortoiseshell butterfly enamoured with the charms of the lady of his species on the branch beneath him. That the object of his attentions was a born coquette there could not be the shadow of a doubt, for there she was fidgeting on the end of the stem, continually opening and closing her wings as if to attract his attention. Meanwhile, her suitor remains comparatively quiet.

After watching her restless movements for some time, Mr. Tortoiseshell apparently decided to make an advance, as shown in No. 2, the two photographs there being almost identical, as during the one-sixteenth second interval little or no movement was made. Miss Tortoiseshell was immediately alert the moment he commenced to move, as the photographs show.

Then, without further ceremony, he rapidly turned and gracefully alighted on the branch by her side (No. 3), his capricious

lady instantly making a reciprocal movement, and remaining steadily poised on the branch as if prepared to listen to his proposal. So obviously nervous was her lover, however, that he lost his balance and twirled somewhat clumsily round and round the stem (No. 4) while she quietly surveyed him.

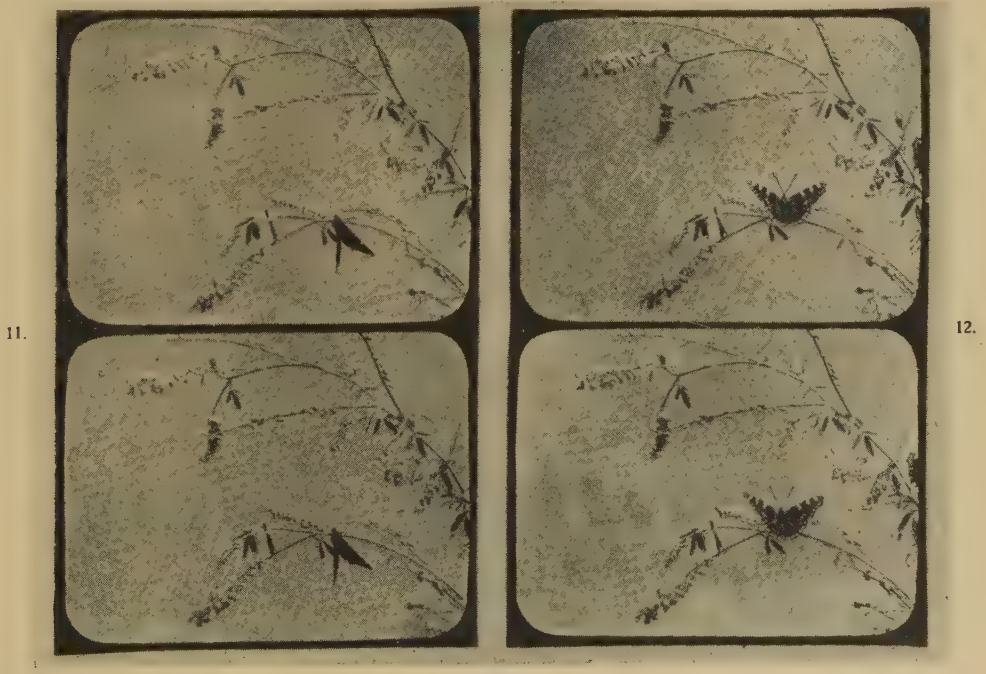
At last he pulled himself together and put on a bolder front (No. 5), and for a time all seemed going well. Then a little difference arose, which apparently developed into a decided " tiff," for she proceeded to turn away from him (No. 6), while he again twirled nervously round the stem.

His activity appeared to irritate his fitful lady, for she suddenly turned towards him with what appeared to be a distinct display of temper (No. 7), and you could imagine that she was plainly informing him that she regarded him as " Absolutely awful and hopeless ! "

Ruthlessly, then, she turned her back upon him (No. 8), while the fluctuating actions of his wings clearly indicated his continual appeal for some consideration. His pleading was all of no avail, for she only turned farther from him, and his falling spirit is plainly shown by his drooping wings (No. 9). Never pausing, she spread out her wings and pushed out into space (No. 10), leaving him rejected and dejected (No. 11).

With all hopes dashed, and wings downcast, he rested for a time. Presently, though, a brilliant burst of sunshine cheered him again to activity, and once more he opened wide his gorgeous wings and exposed them to the sunlight. Surely life was worth living with all those beautiful flowers around to feast upon ! Besides, there were other lady small tortoiseshells ! Whether he thought thus, I am unable to tell, but there he rested with wings outspread (No. 12). At last he whirled around and rose in the air with a buoyancy of life that seemed to imply that perhaps after all he might live to love another day.

Surely, if the recording of details of this kind has become photographically possible, the future of kinematography as an instructional agent in nature study work presents enormous possibilities.



11. 12.

11. Rejected and downcast he hung limply on the stem for a time, but— 12. —a burst of brilliant sunshine revived him, and he spread his wings; after all, there were other lady Small Tortoiseshells !

# Plant Parasites

## 1.—SOME STRANGE ROBBER PLANTS

By S. LEONARD BASTIN

With photographs by the Author

IN spite of the fact that, morally, one must condemn the parasite, most of us feel a little admiration for one sufficiently clever to live wholly or partly at the expense of others. Probably this accounts for the peculiar interest to the botanist which is to be found in the study of the robber plants. The struggle for existence in the vegetable kingdom is extremely severe, and it is fascinating to consider the way in which certain types have contrived to make matters easier for themselves by levying a toll upon their neighbours.

Quite a large number of plants give little indication that they have any parasitic tendencies at all. In a shady wood it is very likely that one will come across a patch of the cow-wheat (*Melampyrum*). This is a delicate plant with pale yellow flowers bearing a strong resemblance in form to the toadflax and snapdragon. If one of the plants as well as some of the surrounding herbage be dug up it will plainly be seen that its roots are tightly joined here and there to those of its neighbours. The connexion is a close one, and is effected by curious disks which grow round the roots of grass and other plants and send down suckers into the tissue. Here we have a good instance of root parasitism, although it is difficult to say just how much the cow-wheat draws from the host plants. Not perhaps a very great deal, for the cow-wheat has green leaves and independent roots which seem capable of absorbing water and salts from the soil on their own account.

Cow-wheat (*Melampyrum*), a delicate plant with pale yellow flowers, affords a good example of root parasitism. It effects connexion by disks which send down suckers into the roots of the host.

This habit of seizing hold of the roots of other plants, and drawing away a certain amount of nutriment, is not confined to the cow-wheat. The louseworts (*Pedicularis*) have very long surface roots which attach themselves to the roots of grass and other meadow plants. The yellow rattle (*Rhinanthus cristi-galli*), which is such a conspicuous

The Yellow Rattle (*Rhinanthus crista-galli*), which is such a conspicuous plant amongst hay-grass, is a common root parasite, but does not live entirely on its host.

plant in the hay grass, is another common root parasite, as is the pretty eye-bright (*Euphrasia*), so abundant by the roadside and on moorland pastures. Altogether, in temperate regions, there are several hundreds of these mild robber plants, most of which, curiously, belong to the orders *Rhinanthaceæ* and *Santalaceæ*.

These parasites, however, are not of a very debased type, but there are others in Britain which must be placed in a different category altogether. Here we have species which are solely dependent on some host for their livelihood. These robbers have no trace of green colouring matter, and if they cannot attach themselves to one of their more thrifty neighbours they will surely die.

Probably one of the strangest of all British plants is the toothwort (*Lathræa squamaria*). This species lives an almost exclusively underground existence, and even the flower spikes are commonly half buried with dead leaves. The toothwort, although never really common, is probably more abundant than is usually supposed. The retiring habits of the plant must often cause it to be overlooked. Anyone who discovers a toothwort for the first time will always experience a feeling of wonder. The plant is most conspicuous in May, when it sends up its thick drooping spike of faded-looking flowers of a pale lilac shade. Mostly the toothwort is parasitic on the roots of hazel and poplar.

The blossoms of this weird plant are strange enough, but there is even more of interest to be found in the stem, which is quite beneath the ground. This is closely set with sharp-edged white scales which bear a remarkable resemblance to human teeth. Thin roots spring from the stem, and these are attached, here and there, to the roots of the host plant by means of small suckers. The stem of the toothwort is worth a close examination. In each tooth-like scale there is a cavity with a very narrow entrance. This cavity is lined with glands, and it would seem to form a perfect insect trap. Now and again tiny creatures are found in the hollow of the scales,

An enlarged view of the sucker of the Yellow Rattle attached to the root of grass. It is one of the mild robber plants belonging to the order *Rhinanthaceæ*.

This species of Toothwort (*Lathræa clandestina*) although common on the Continent is only met with in Great Britain in Botanical Gardens.

and, in many books, it is declared that the toothwort is really an insectivorous plant. It is, however, now known that the *Lathræa* is not a carnivorous species at all; the glands in the cavities are water-secreting processes.

The toothwort lives largely underground where the conditions are extremely moist, especially in the springtime. As a result the plant has a great difficulty in getting rid of its superfluous moisture, and the trouble is surmounted by giving out the excess in liquid form through the agency of the glandular hairs.

Although they are not perhaps quite so striking as the toothworts, the broomrapes (*Orobanche*) form a most interesting group of root parasites. These robber plants grow on the roots of thyme, scabious, grass and many other kinds of plants. Some species confine their attention to one sort of host plant and are never to be found on any other. On the other hand, certain species of broomrape do not seem to trouble much what is the nature of the host to which they are attached.

Like the *Lathræas*, the *Orobanches* are quite destitute of chlorophyll. In general appearance they are mostly of a dull brown shade and are commonly taken for nothing more than the faded flower spikes of some plant that has had its day. In the case of the toothworts it is not a difficult matter to separate the parasite from its host. With the broomrapes, however, the union is much more complete. Here it is often a difficult matter to tell where the tissues of the parasite end and those of the host begin.

The seedling of the broomrape is very curious. It bears no trace of cotyledons, and is a delicate thread-like structure, one end of which is hidden by the remains of the seed, whilst the other extremity goes in search of roots to which it may become attached. If these cannot be found, the seedling soon dies, for it seems unable to absorb anything in the way of food from the

Curious as are the flowers of the British Toothwort (*Lathræa squamaria*), the stem, which is quite under the ground, is more curious still. It is closely set with sharp-edged white scales bearing a remarkable resemblance to human teeth. This Toothwort is parasitic on roots of hazel and poplar.

The comparatively large and handsome flowers of the Toothwort (*Lathræa clandestina*) are not arranged on a spike, and are of a peculiarly rich violet shade.

The Toothwort (*L. squamaria*) growing on the roots of hazel, one of its most popular hosts.

Section of stem of Toothwort (*L. squamaria*) showing the peculiar dentate scales and the gland-lined cavities.

The Lesser Broomrape (*Orobanche minor*) lives on the roots of clover, carrot, ivy, &c. It is often a difficult matter to tell where the issues of this parasite end and those of the host begin.

soil. Should the root of a suitable host be discovered, great changes take place in the character of the young broomrape. It quickly becomes very intimately associated with the root of the host and develops into a knotted structure not unlike a tuber. From this the brown flower spike, with a few useless leaves, is sent up.

When the flowers really fade the formation of the seed pods begins. The seeds are remarkable on account of their diminutive size. They are so small and light that they are largely distributed by air, although they have no winged attachments such as are to be found in the typical flying seeds.

There are quite a number of species of *Orobanche* in Britain, and some of these are more common than is generally supposed. One of the most striking is the great broomrape (*O. major*), which sends up a flower spike that may be nearly a foot high. This is parasitic on the roots of furze, broom, and other leguminous plants.

Similar in appearance, but of smaller size, is the lesser broomrape (*O. minor*), which grows on clover, carrot, and has been found on ivy roots. There are several varieties which some botanists have regarded as distinct species. Two or three of the rarer species include *O. carophyllacea*, which has a perfume resembling that of cloves, *O. elatior* and *O. cærulea*. The last-mentioned, although not of great size, is perhaps one of the most distinctive in that the flowers have a purplish-blue colour. This species is fairly common in some parts of the Isle of Wight, and it has also been found in Norfolk. Anyone who wishes to find broomrapes will have an excellent chance of doing so during a visit to the coast. For some reason which is not clear, the *Orobanches* are more abundant fairly near the sea than in inland positions.

It is often asked whether these root parasites do much harm to the plants which are their hosts. There is little doubt that where the yellow rattle is abundant it does damage pasture, and farmers have always looked with disfavour on the plant. Even greater harm has been done to clover crops by the broomrape in seasons favourable to the parasite.

Another species of the Broomrape (*Orobanche cærulea*) is one of the most distinctive members of the family in that its flowers are of a purplish-blue tint.

*Photo: Frances Pitt.*

The habits of the Badger are for the most part nocturnal. Only on rare occasions does one get a sight of him in his walks abroad.

# 8.—BROCK, THE BADGER

By FRANK BONNETT

MOST people, probably, would be surprised if they were to be told that the badger is by no means an uncommon animal. For seeing is believing, and those who do not see are apt to disbelieve. The badger is one of the most retiring of wild creatures, his habits for the most part are nocturnal, and it is only on rare occasions that one may get a sight of him either in his haunts near home or in his walks abroad. There are, in fact, even among those who have lived all their lives in the country, very few who can claim to have set eyes on a live badger under natural circumstances, though sometimes on a moonlight night they may be fortunate enough to catch a fleeting glimpse of a dusky form stealing along the edge of the coppice or gliding noiselessly through a gap in the hedgerow.

Should one be familiar with his ways and be really set on seeing him, it is not altogether difficult to make his acquaintance at close quarters, provided it is remembered that the badger is a creature whose senses of sound, sight and smell are much more alert than those of man. If one comes along a little before dusk and, paying due attention to the direction of the wind, should be able to secrete oneself somewhere near his haunts, the chances are that after keeping perfectly still, maybe for an hour or so, one will be to some extent rewarded. Even though he affords a full view of himself, however, Brock is not likely to tarry long in anyone's presence. He does not walk blindly into the open, but cautiously creeping forth, will scent the air for possible danger ere proceeding on his business. Therefore, unless the hiding-place be very carefully chosen, it will most likely be discovered, and that will be the end of it for that particular occasion. Brock will go back into his earth in a flash, and for the next few hours, possibly for the whole of that night, he will

lie *perdu* in one of the innermost recesses of his many-galleried retreat.

With better fortune one may see him emerge into the open, hesitating every now and again to test the atmosphere and to listen for the slightest suspicious sound,

*Photo: Messrs. H. Mortimer and Wm. B. Batten.*
Impression of the foot of an adult dog Badger. By filling in the footprint with silver sand, the photograph was made possible.

but not wasting much time once he has assured himself that the coast is clear. The light will be bad unless there be a moon or sufficient afterglow from the west, but with a fair measure of luck one will have been able to see as much of a retiring individual as can ever be seen of him amid natural surroundings, and with that one must be content. The badger, at any rate, will probably leave his home down-wind, choosing one of several well-beaten tracks that lead to and from it.

These tracks, by the way, are well worth inspection by daylight, for they will reveal not a little of the badger and his ways. A large " earth," which may be the home of many badgers, will cover a space of thirty or forty yards in length and perhaps half as many in width. It will be found usually near the top of a gently sloping bank, extending downwards for a considerable distance, or it may be established on the crest of a little hillock, with workings reaching down on one or more sides.

The badger, above all things, loves being dry and warm, hence his choice of a situation where wet cannot reach him. He is careful, too, to choose a spot that is sheltered from the colder winds. Sunshine, however, does not very much concern him. Except when he is obliged to do so by force of unusual circumstances, he stirs abroad only by night, though sometimes, maybe, after a long night's journey daylight may overtake him some little time before he reaches home. But the sun does not enter much into his calculations when he is setting about the choice of a domicile. He prefers shady places, and for good reason. In the summer the shade from branches overhead helps to keep his dwelling from becoming too warm ; in the winter, when he is mostly asleep, it does not matter to him whether the sun shines through the branches or not, except that if its feeble rays tend to keep him a little warmer in bed, so much the better.

But the roots and stems of the trees that grow about his dwelling are very much to his advantage at all times. The roots tend to his greater security, and in some cases render his stronghold wellnigh impregnable, and the stems, while serving to some extent to cover his movements, also provide him with convenient " rubbing-posts " close at

*Photo: Messrs. H. Mortimer and Wm. B. Batten.*

**THE BADGERS' PLAYGROUND.**

This "earth" contained a family of young Badgers, and the distinct run-way that they made from the burrow mouth to their playground (marked by a handkerchief) revealed the presence of the animals.

hand. How essential these are to him may readily be discovered by examining the tree-trunks near the badger's earth. Every one will show signs of having been rubbed by his body, for here and there hairs will be plainly seen still sticking to the bark. The tree-stems and the low drooping boughs of the undergrowth are his brush and comb,

Photo: Frances Pitt.

The Badger is an omnivorous creature, and is ready to sample anything that comes his way. Here he is shown foraging for odds and ends by a pond-side.

and by such means does Brock keep his glossy coat in good order.

A large badger earth has many entrances and exits, and each of these is connected with every other—sometimes by the shortest and most direct route, but often by more or less circuitous tracks, with short pathways leading to every door. Where several badgers dwell in the same home, it would seem as though each pair or each family paid frequent visits to its neighbours, from which it may be concluded that the badger is as sociable a beast as the rabbit or the rat; and that while, doubtless, each family has its own particular apartments, there is much social intercourse and a good deal of common ground in every earth.

For the space of many square yards around the earth the ground is trampled by many feet into well-defined paths, almost as hard as a roadway, and at two or three different points main roads strike off into the surrounding country, becoming less and less distinct until they are completely lost. While the badger makes no attempt to conceal his tracks near home, he is careful not to make his whereabouts too patent to the world at large. Anyone may find the earth by diligent search, or may stumble upon it, perhaps, by accident—these possibilities the badger cannot guard against—but he is not going to assist the curious to discover him if he can avoid it.

Young badgers, like fox-cubs, have their playgrounds, to which they resort for a game among themselves when time hangs heavy on their hands. The playground is approached by a well-beaten track, leading from one or more of the earth's exits. This habit of reserving a special area for recreation away from the earth seems to be prompted not so much by a desire for concealment as with the object of preventing the immediate neighbourhood of the earth from becoming fouled.

The badger is in the habit of going long distances in search of food. He subsists very largely on the wild roots of the woodlands—bluebell bulbs are an especial delicacy with him—but he will often leave acres of good feeding-ground near home untouched, so that there shall be no trace of his activities to draw attention to the existence of the earth close by. Possibly, like the fox, the badger has another reason for this apparent neglect of food near home. Sustenance for the younger members of the family, so soon as they are old enough to forage for themselves, must be provided fairly near at hand, for the little badgers are not to be en-

*Photo: Messrs. H. Mortimer and Wm. B. Batten.*

When the earth is found scratched away from the roots of trees, this is sure to be the work of Badgers. Possibly they do this in the course of their hunt for insects which congregate in the bark.

couraged to go long distances by themselves. For one thing, they are not strong enough to make long journeys; for another, they are ignorant of the ways of the world and its many dangers. Also, they must learn very thoroughly the geography of the country round, and that knowledge is only to be acquired by slow degrees.

For the collection of his bedding material also the badger goes some little distance away from home. He is one of the cleanest of animals — far more particular, indeed, in this respect than the fox. Very frequently he finds it desirable to renew his bed-clothes, though a less fastidious creature would certainly save himself this constant trouble. A large amount of material is used up in this way, and if it were all collected close at hand, the traces of the badger's doings would be too patent to escape detection.

The badger's diet is not wholly confined to the roots and bulbs of wild plants. He is an omnivorous creature, and like the hedgehog is ready to sample almost anything that comes his way. For this reason he is not beloved of the gamekeeper, who, one fears, is only too ready to lay to the badger's charge many a crime of which he is innocent. That the badger will, on occasion, destroy the nest of pheasant or partridge must perhaps be admitted, but against this there is the testimony of many a game-preserver and naturalist (not an impossible combination, as some suppose), that in this direction badgers do but little harm, while there can be no doubt that they

*Photo: Messrs. H. Mortimer and Wm. B. Batten.*

Badgers change their bedding every few nights, collecting it at some distance from the burrow. This photograph shows a tightly-rolled bundle that has been dropped on the run-way.

contrive to accomplish no small amount of good.

There has been for many years past a large colony of badgers in a certain Kentish wood in which numbers of pheasants—both wild and "tame"—have been reared annually, a thing that would have been impossible were badgers such enemies to gamebirds and their eggs as is generally believed. On many occasions the coops containing the young pheasants have been placed in rides close to the principal earth, yet although the badgers will come at night know when a rabbits' "stop" has been rifled by Brock himself and no other, for so keen is his sense of smell that he can locate the nest from the surface of the ground immediately above, thereby saving himself the labour of digging up to it from the entrance of the hole. For the rest, the badger satisfies his taste for meat with the nests of young rats and the various species of mice that are to be found in every bank and hedgerow in the spring. Like the fox, he will also eat insects when obliged to do so, while as autumn approaches wild fruits

*Photo: Frances Pitt.*

A young Badger in the act of devouring the carcass of a blackbird found on its ramble.

and actually rub themselves against the coops, hardly a bird has been missed, even when the coops were left open. For such birds as disappeared either accident or the act of some wandering rat or other vermin was probably responsible, for had the badgers once begun to take the young pheasants they would hardly have been content with just a few. At any rate, although a strict watch has always been kept on the badgers' habits, no charge against them has ever been sustained. To this day, therefore, they are still permitted to go their way without let or hindrance.

Probably the worst crime that can be substantiated against the badger—and in some places even this habit might be accounted a virtue—is that of the destruction of young rabbits in early spring. But this does not last for long. So soon as other food becomes more plentiful the badger leaves the young rabbits unmolested, and in some seasons the toll he takes in this direction is very small. One may easily of almost any kind help him to eke out his existence.

In his search for insects the badger frequently routs around the trunks of trees—that, at least, is supposed to be the object of this constant habit. At the base of a rough-barked tree-stem there are many cracks and crevices in which beetles and other small creatures are prone to congregate; but possibly the roots of the tree itself or some fungus that grows in such places may provide an alternative or additional attraction. Sometimes, perhaps, when searching around and under the gnarled roots of forest trees, the badger is lucky enough to happen upon the hidden store of some other denizen of the woods. All is fish that comes to his net, and one can well picture his satisfaction at discovering the hard-won treasure that some luckless mouse has so laboriously got together.

On the whole, the badger is to be reckoned a quiet and inoffensive creature. He asks

only to be left alone, but he is prepared to fight, and fight manfully, once he finds himself in a tight corner. He never appears to seek a quarrel with anyone, and sometimes makes the strangest of friendships, for before now foxes, and even rabbits, have been found sharing his home. As for man, Brock is quite prepared to make friends if treated in the right fashion, and a young badger is no more difficult to tame than a fox-cub if he has never known a life of liberty.

Not always, however, can Brock regard man as his friend. Opinion may differ as to the amount of sport to be derived from the practice of badger-digging, though in some parts of the country the creature may owe his existence to the fact that he is preserved for the sole purpose of providing this diversion. But Brock really has no pretensions to being a sporting creature like the fox. Now and again, it is true, he is hunted by hounds, but more often by accident than design, and the huntsman would prefer to be without him. Though he can cover a great deal of ground if given the time, the badger's paces before hounds are not good enough to provide a run of any importance, while the education he provides for the young entry of the pack is not altogether desirable.

The day when the badger may become extinct in this country is probably far distant, few though there be who take any real interest in his welfare. At the worst he is a tolerated beast in those parts where he still exists, for if his real friends are few, his enemies are nowhere very numerous. He has, it is true, disappeared from many places where he once was a common creature of the countryside, but this is due rather to man's encroachment on his haunts than to any direct hostility. On the other hand, the badger's numbers have increased in other districts, and if those habitats which are to his liking should become only half as numerous as they are to-day, Brock would still find it possible to dwell in peace and seclusion. At any rate, so long as fox-hunting flourishes in this country, the badger's home will be secure, for the natural requirements of the two creatures are very much the same.

But the badger always has this in his favour as compared with the fox—for the greater part of the hunting season he is safe below ground. Hounds, therefore, have little chance of finding him, though sometimes either by accident or design a digging party may come upon him. At times, too, the earth-stopper may close his home against him in the attempt to keep a fox above ground. The badger is no coward when danger meets him face to face, but there is little daring in his nature, and he owes his existence largely to the avoidance of risks, no one knowing better than he that "discretion is the better part of valour." That indeed, with "Live and let live," would seem to be the favourite motto of Brock, the badger.

It is to be hoped, then, that all those whose premises this peace-loving creature is wont to honour with his presence, will do their best to protect him on all occasions. He is too interesting an animal to lose, and his long years of residence in these islands entitle him to our respect.

*Photo: Frances Pitt.*

Two young Badgers on a foraging expedition; the near one is interested in some carrion that it has found.

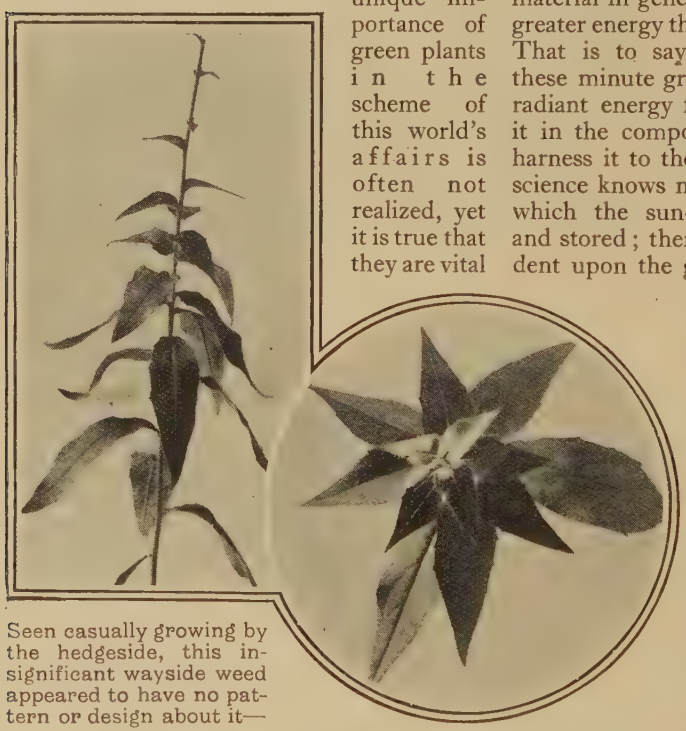
# By-Ways of Plant Life

## 3.—HOW THE LEAVES SECURE A PLACE IN THE SUN

By G. CLARKE NUTTALL, B.Sc.

With photographs by the Author

SUNLIGHT—radiant energy—is the sole power that drives the machinery of plant life, and to that machinery has been given the most wonderful work on earth—the building up of life. The unique importance of green plants in the scheme of this world's affairs is often not realized, yet it is true that they are vital to the whole of life, and hence to civilization in general. They, and they alone, by virtue of their greenness, i.e. through the kind offices of myriads of minute green bodies which they contain and whose sum makes up the green coloration, can take the simple elements of air and water—inorganic elements—and, driven by the sun, they can build them up into complex, organic substances, such as starch and sugar, and ultimately plant material in general, which are compounds of greater energy than their simple constituents. That is to say, in some mysterious way these minute green bodies can actually take radiant energy from the sun and imprison it in the compounds they build, and thus harness it to the needs of the world. And science knows no other practical means by which the sun-energy can be intercepted and stored; therefore we are wholly dependent upon the green plants for our lives.



Seen casually growing by the hedgeside, this insignificant wayside weed appeared to have no pattern or design about it—

—until one looked right down upon it; then one saw that the leaves were arranged in a spiral so that each received the utmost possible amount of sunlight.

Coal, which to-day is a fundamental factor in our civilization, was built up ages ago by green plants from air and water, with energy transferred to it from the sun, energy which is set free for our benefit after long ages.

It follows, therefore, that the first thing necessary to the living green plant is sunlight. Further, given the presence of sunlight, it follows that if it would derive the greatest benefit from the sun's rays it must arrange its leaves and other parts which contain green colouring in such positions that the rays fall directly upon them. To fulfil this aim the whole resources of a plant are directed. And our object now is to show, firstly, how plants will

act in ordinary normal circumstances to meet every contingency and, secondly, to give some curious examples of the desperate efforts they make to reach the sunlight when its access to them presents difficulties — efforts that remind one of those made by imprisoned men, suffocating from confinement.

First, then, how does a plant manage its leaves—

Some plants like the Golden Rod (left) and the Convolvulus (right) place their leaves, often on different stems, like tiles on a roof, to secure the full benefit from the sunlight. To effect the same result, the spiral of the Hollyhock (centre) is obvious.

those manufactories where the work of building-up is done? How does it place them so that they can best avail themselves of the radiant energy of the sun; in other words, how best to become "traps to catch sunbeams"? On every hand, and often most unexpectedly to the uninitiated, we see a beautiful plan and design in leaf arrangement. Take the wayside weed, for instance, that is shown in the first photograph. Seen casually growing by the hedgeside it was quite unattractive, and at first glance there seemed no special purpose in the arrangement of its rather uninteresting leaves. But getting above it and looking down upon it from the direction of the sun's rays, that unattractive weed became for us at once a thing of beauty and purpose. For, behold, the leaves were arranged in a spiral, the smallest at the top, the rest in increasing sizes in order down the stem, a spiral which allowed every leaf to secure the maximum amount of radiant energy with the minimum amount of shadow. It provided an instructive lesson. This weed grew far enough from the hedge-row to receive a fair amount of light all round, hence it was erect; but everyone knows that when any plant, say, Jack-by-the-hedge (*Alliaria officinalis*), grows under the hedge the stalks will lean out towards the light, while its leaves range themselves in suitable positions on the stalk.

Most plants have their leaves arranged in spirals, spirals whose turns may be of various distances apart and with a varying number of leaves allotted to each turn, that is to say, the number is variable as regards different species but always constant on any one kind of plant. It all depends upon the shape of the leaf; thus a certain willow with round leaves has three to each turn of the spiral, the goat willow with oval leaves has five leaves in two turns of the spiral, while the bay willow with narrower

leaves has eight leaves to five turns of the spiral. Sometimes the spirals are obvious, as in the hollyhock here pictured. Sometimes they are arranged to look like the tiling on a roof, one overlapping the other, as can be seen in the convolvulus and the golden rod, where the leaves on several stems may combine to form the pattern, but always there is order and method and a definite plan in their arrangement.

Three twigs of Syringa (*Philadelphus*) with their short-stalked leaves. The upright branch (A) carries its leaves in pairs at right angles to one another—all leaves facing the sky. On the branch (B) rising sideways, the leaves, in order to keep their faces to the light, have to twist round—making various angles with the stem. Again, on the branch (C) growing horizontally, the leaves are so arranged that they all lie (also in pairs) in the same plane, still facing the light, which is the main point.

Again, consider a tree. At a distance it appears to be just a mass of foliage, and one cannot, with any certainty, detect any special order or design in the placing of the crowd of individual leaves that compose its thick crown. They just seem to "happen" all over the branches. Yet the fact remains that every individual leaf on that tree is so adjusted that it gets the maximum amount of sunlight possible. Look, for instance, at these three twigs cut from a syringa (*Philadelphus*) and the short-stalked leaves upon them. On the twig which grew bolt upright the leaves are in pairs at right angles to one another all up the stem, thus the leaves of any one pair are not materially overshadowed by the leaves of the pair above, and they all face the sky and get the sunlight. The second twig grew out sideways at about half a right angle to the vertical, and the leaves, though still, of course, in pairs, are now twisted so that they make such various angles to the stem as will keep their faces still directly turned to the sunlight. Their positions are very different from those on the first twig. So, too, are those of the third twig which grew out horizontally, where one set of pairs have had to twist their faces through a right angle, while the alternate set must not only twist their faces but lay themselves right back in such a way that all are in the same plane to face the sun. A careful consideration of the accompanying photographs shows the aim of the tree better than any verbal description. A pretty little

On this horizontal branch of a Sycamore the leaf-stalks have actually grown to varying lengths, so that the leaves fit one into the other like a mosaic. Note also that they all lie in the same plane facing the sun.

experiment can be made by selecting a twig on a tree and tying it at a different angle from that in which it is normally growing—say, tying a vertical twig in an almost horizontal position. In a few days the leaves upon it will be found to have greatly altered their positions in an attempt to meet the new conditions.

Further, consider these small branches of the sycamore, with their long stalked leaves. As before, on the upright branch the leaves are regularly arranged in pairs at right angles up the stem. On the horizontal branch not only have the leaves so twisted their positions that they all lie in the same plane facing the sun, but the individual stalks of the individual leaves have actually grown to exactly the right lengths to enable the leaves to fit one into the other like a mosaic. Notice how the stalks of the lowest pair vary in length and how, too, the longer-stemmed one on the left has crossed the stem of the one above in order to reach the more open space. In the foliage of the horse-chestnut (p. 464) is another pretty illustration of the point at issue. This foliage is built up of little groups each of four leaves—two pairs. On the upright twig the whole group stands erect like a small Japanese umbrella, while on the horizontal twig it just lies *along* the branch instead of at right angles to it, and on the branches growing between the vertical and the horizontal directions the whole group takes up a correspondingly intermediate position. So wherever we look we find these mosaics and designs—traps to catch sunbeams. Sometimes they are more perfectly arranged and more beautiful than at other times, as, for instance, in the horizontal branch of the lime (p. 464) where the four lines of leaves form a delightful mosaic, but they are always interesting. Indeed, these leaf patterns and foliage designs present one of the most fascinating sideshows of plant life.

So far we have been dealing with the

As before, on the upward branch of a Sycamore the leaves are set regularly in pairs at right angles up the stem.

ordinary efforts of leaves to meet varying but normal conditions of light. Let us now see how plants act when they find themselves placed in abnormal conditions. Here is an instance in the case of a plant of London pride. On the left of the picture (p. 465) is the ordinary rosette of this accommodating and ubiquitous plant. It was growing in a garden with its usual allowance of sunlight; but an adjacent rosette was taken up and planted in a large bowl where a miniature garden was being formed. By mistake the bowl was eventually moved to the darker side of the room right away from the window, and left there for a week or so. When again brought to the light it was pitiful to see the desperate efforts that the little plants in the miniature garden had made to get an adequate supply of the necessary sunlight. The London pride rosette, starved of its light supply, was making a gallant but futile attempt to reach the light before it was too late, and its normally dwarf stem had started to grow towards the window. It was sacrificing its leaves to the needs of its stem,

for these had ceased growing, and those nearest the tip were exceedingly minute. Moreover, both the leaves and the stem were almost colourless — the plant was not going to produce the green colouring bodies until there was some work for them to do. In fact, it was devoting every power it possessed to reaching salvation in the shape of sunlight; it appeared to be almost *crawling* to the light instead of sitting and basking in it as was the attitude of its more fortunate brother in the garden.

The Horse-chestnut's foliage and its adaptations to circumstances. On the vertical twig the leaf-group is transverse to the twig—like a little Japanese umbrella; on the horizontal, the leaf-group is in a line with the branch; on branches at intermediate angles the leaf-group makes corresponding angles with the stem.

In the same bowl had also been planted some tiny houseleeks, one of which is "A" in the next photograph, and they, too, cut off from the light, were acting in a similar manner. There again the middle of the houseleek had begun to grow out in a manner that was entirely foreign to its

A beautiful mosaic on a horizontal branch of Lime. Notice how cleverly the leaves "fit in."

A B

Compare A, an ordinary rosette of London Pride growing in a garden having plenty of light, with B, a poor plant which was placed in a dark corner of a room—and forgotten. The latter is making a desperate effort to grow to the light at a far-distant window.

nature, and the little leaves instead of being clustered together were scattered along the stem. In "B," a plant only midway back, the stem was only a little elongated and the outer part of the old rosette still clustered round its base. But look at "C." Here the plant is in an extremity of desperation. All the original leaves of the rosette have been drawn upon for nutriment and sacrificed to build up the stem rapidly extending in the direction of the window. The position is one of "now or never." There are long distances between such tiny colourless leaves as do exist, and towards the tip there are no leaves at all. After a time, if sufficient light is not attained, the unfortunate plant, attenuated, colourless and the picture of misery, must die. Sunlight is vital to green plants just as green plants are vital to man.

A little wild crane's-bill afforded a striking and almost incredible instance of a plant adapting itself to abnormal conditions—an instance so striking that it was difficult to believe there was not a mind working behind it. On the top of an old wall in the Lake District the writer found a number of little crane's-bills embedded in moss and lying flat upon it, leaf patterns upon a velvet-like background. Each formed such a beautiful mosaic that the short central stem of one was cut across (its roots left in the moss) and, carefully laid upon a book to keep its "pattern," was taken home to be photographed. The illustration on page 466, looking straight down on the plant, was the result.

This finished, the plant was useless, but it was so charming an object that one hesitated to throw it away, so it was carefully put with a little water at the bottom of a deep sponge dish at the back of the washing-stand—and forgotten. Two or three days later a friend said, "Whatever is this?" and there lay a most remarkable-looking object, more like some quaint little vegetable than a beautiful mosaic. The centre of the plant had humped itself up some two inches, using its outer ring of leaves and their stalks as feet and legs for this purpose, and sacrificing them as leaves, for they were already turning yellow and beginning to decay. Meanwhile the younger and more central leaves and stalks were stretching up towards the light like yearning arms. It was at once obvious that this was the plant's last desperate effort to reach the light above those dark imprisoning walls of the sponge dish. It was a remarkable feat when one came to look into it. All the leaves were equally fresh and green at the outset and all on the same level. How was it, then, that in this emergency they jointly initiated a rational scheme which demanded that the outer leaves and stalks should press *downwards* and hoist the central part—no light

Witness the efforts of a starved Houseleek to obtain an adequate supply of sunlight. A is the normal plant; B is a plant at some distance from the light; C, a plant placed far back from the light, and, sacrificing all, is making a frantic effort to reach it before it is starved to death.

weight—into the air towards the light, while the younger leaves on their shorter stalks should press *upwards* to attain a still higher level? It is precisely the course of action two men would take to reach something beyond the grasp of either. One man would be "legs" and hoist the other on his back, and the latter would reach upwards to the desired object. We have seen, moreover, that leaves have a tendency to grow towards the light; what instinct, then, made these outer leaves renounce this tendency? Further, as the central part and the up-reaching leaves were still fresh, green, and turgid, the water they required must have been absorbed by the "feet-leaves" and passed upwards along their down-pressing stalks. In fact, the whole affair was a remarkable episode, and presents a conundrum most difficult to explain in a plant where there is neither consciousness nor intelligence.

The whole subject of growth in relation to light is peculiarly fascinating, and experiments on the lines of the above accidental incidents, but originated by design and carefully noted, might be made by any one anxious to explore the by-ways of Nature and the resourcefulness of plants to meet exceptional difficulties. Their ingenuity is probably not less than that of some of the prisoners who escaped from war prison camps. The writer found most weird objects resulting from growing crocus bulbs at the dark end of a long cellar where there was a small window at the opposite end. These objects were thick, fleshy and about five inches in height; variously contorted, as though carved out of ivory, and totally unrecognizable as crocus plants. And these abnormalities are not mere curiosities, but help to show what qualities of life are directly induced by the presence of sunlight.

This little wild Crane's-bill (A) grew flat on the top of a mossy wall and spread its leaves in this beautiful mosaic to the sunshine. A remarkable transformation (B) occurred after the plant had been left for several days at the bottom of a deep sponge dish away from the light. In an heroic attempt to reach the light, the outer leaves and stalks became feet and legs to hoist the plant upwards, while the younger ones stretched upwards like arms.

Another wide field of research which we commend to the student of the curious is that of the growth of plants in different coloured lights, e.g. red, blue, green, that is, in sunlight from which the various constituent rays have been eliminated. Here again there are most remarkable results, the full measure of which has yet to be ascertained.

The Great Black Back Gull is the largest member of the family found breeding in the British Isles. It is about thirty inches in length, and weighs nearly five pounds. This bird has been known to carry off a dead lamb.

# 20.—THE GREATER AND LESSER BLACK-BACKED GULLS

By RICHARD KEARTON, F.Z.S., etc.

With photographs by the Author

THE two gulls here treated are both common in and around the British Isles throughout the year, with a very noticeable increase in their numbers during the nesting season; this fact is accounted for by their gathering from all the seas and congregating in their time-immemorial breeding quarters. They are both omnivorous. No kind of carrion comes amiss. I have seen them attack dead rats and whales with equal zest. Some years ago whilst I was studying wild-bird life in the Shetlands, two dead whales, supposed by the natives to have been killed in a fight, drifted ashore on different islands, and for days on end clouds of great black back, lesser black back and herring gulls tore and feasted, fought and yelled in the midst of an indescribably foul stench.

Both the birds under notice are inveterate egg-stealers, hence their presence is not welcomed near any game preserve. The lesser black back has been known to choke itself with a wild duck's egg.

With a wing expansion of close upon six feet, the Great Black Back Gull planing down to alight, presents an illustration of perfect control of movement, power, grace, and beauty.

The flight of these gulls is easy and graceful, and I have often marvelled at the celerity with which they will catch up and follow an ocean liner travelling in the teeth of a stiff breeze. Should a quantity of broken food and scraps be thrown overboard, all the birds in the neighbourhood will pounce upon it, and, in the wake of the boat, make the sea boil in their endeavours to secure the most delectable titbits; but directly all the food has been devoured, those with any capacity left for more will rise into the air and by a

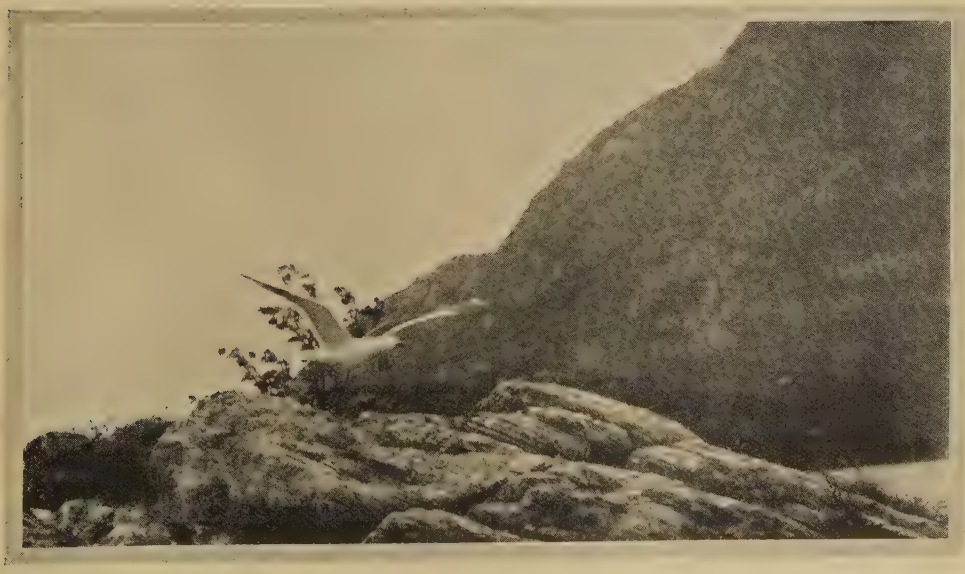
When at rest, the autocrat of the winds and waves, the Great Black Back Gull, stands out conspicuous in the sable mantle which earns him his name.

Leaping off a rock in order to gain room for the downstroke of his powerful wings the Great Black Back Gull begins to rise.

few strokes of their powerful wings overtake the ship, and calmly float over her on outstretched pinions without the slightest apparent exertion.

The great black back gull is the largest member of its family found breeding in the British Isles. It is about thirty inches in length, has a wing expansion of close upon six feet, and weighs nearly five pounds. The sexes are similar in appearance, but the female is a little smaller.

Although scattered all round the English and Welsh coasts in winter, where it may be seen standing on mudflats and sandbanks,



A second or so later, he attains the full stroke of the great wings, and gracefully soars to his kingdom of the air.

a veritable giant compared with the common and black-headed gulls around it, the great black back mostly retires to Scotland and Ireland to breed in the springtime. In the early decades of last century, according to Yarrell, the great black back used to breed as close to London as the estuary of the Thames, where it was known as " the cob."

The great black back is frequently confused with its more numerous relative the lesser black back gull, of which it may be said to be a larger edition. Size is not a very safe guide to identification, however, when the bird is on the wing or standing at a considerable distance, as atmospheric conditions have to be reckoned with, and are sometimes apt to be misleading. I have called up an old cock grouse at break of day upon a misty morning, and upon alighting on a heather knoll five-and-twenty yards away he has appeared to loom as large as a turkey.

Safer guides to correct identification are: (1) the great black back has flesh-coloured legs, whereas those of its relative are yellow; (2) the black of the bird's mantle or back is of a more intense character than in the case of its congener. The loud harsh barking notes of this gull are also distinguishable from those of any other member of the family.

The strength of the great black back is enormous. I have found a dead lamb lying by a nest built on a small island in the Hebrides, in circumstances that proved it had been brought from a considerable distance. Grey mentions an instance of a great black back, " shot on the Farne Islands at some distance from the water, that was found to have swallowed a piece of fish about four inches long, to which had been fastened two hooks and a strong line thirty-seven feet in length with a stone seven pounds in weight at the end," the inference being that the unlucky bird had flown with this enormous weight from the mainland to the Farne Islands.

The flight of the Lesser Black Back and the Herring Gull is at once easy and graceful. When flying against a stiff breeze in the wake of a steamer, the birds make a marvellous speed.

At St. Kilda I have seen one of these birds kill and tear a sickly puffin to pieces; indeed, such is its swallowing capacity that it has been known to gulp down whole a bird as large as a redshank.

Of the bird's great intelligence I have had many proofs. Some years ago whilst studying wild or grey lag geese at home in their breeding quarters, I was astonished to discover that every nest I found and examined was robbed within a few hours, in spite of the fact that I covered the eggs over carefully with down, and even increased the density of the canopy of heather overhead.

Ultimately I discovered that I was being carefully watched by two or three pairs of great black backs hovering in the air above, and that the birds were taking advantage of my researches. A keeper who accompanied me one day shot at them as they wheeled about, but although we could distinctly hear his No. 4 shot rattle on their wing quills, it had no visible effect except to make the birds soar to a higher altitude.

On another occasion I had a keeper out helping me to photograph the specimen shown in our illustration, on a small rocky island in the middle of a Highland mountain loch. My bird and other members of a small colony in which it lived did not seem at all to mind the man as he fished and waited for me in the distance, but when I was accompanied a day or two afterwards by a different keeper, not a bird would come near the island whilst he was within sight of it, although I waited long and patiently. I learnt afterwards that this man had shot at the birds some days previous to my first visit. They knew him again undoubtedly, and were running no risks.

This species is gregarious in some places and solitary in others. I think the largest colony I have ever seen is on the Holm of Noss, close to Lerwick, in the Shetlands. There is no access to this more or less flat-topped rock-stack since the cradle that used to travel slung on ropes across the yawning chasm separating the rock-stack from the island of Bressay was destroyed, and the birds are thus enabled to breed in perfect safety.

I have been told it is impossible to throw a stone on to this rock-stack and also a similar one near to Thurso, upon which gulls breed from the mainland, but as a matter of fact I have landed stones on both of them when I was younger, which will give the reader some idea of their closeness to the shore.

Down-clad young of the Great Black Back Gull leave the nest soon after they are hatched. It is said that they do not attain their full adult plumage until the fifth breeding season.

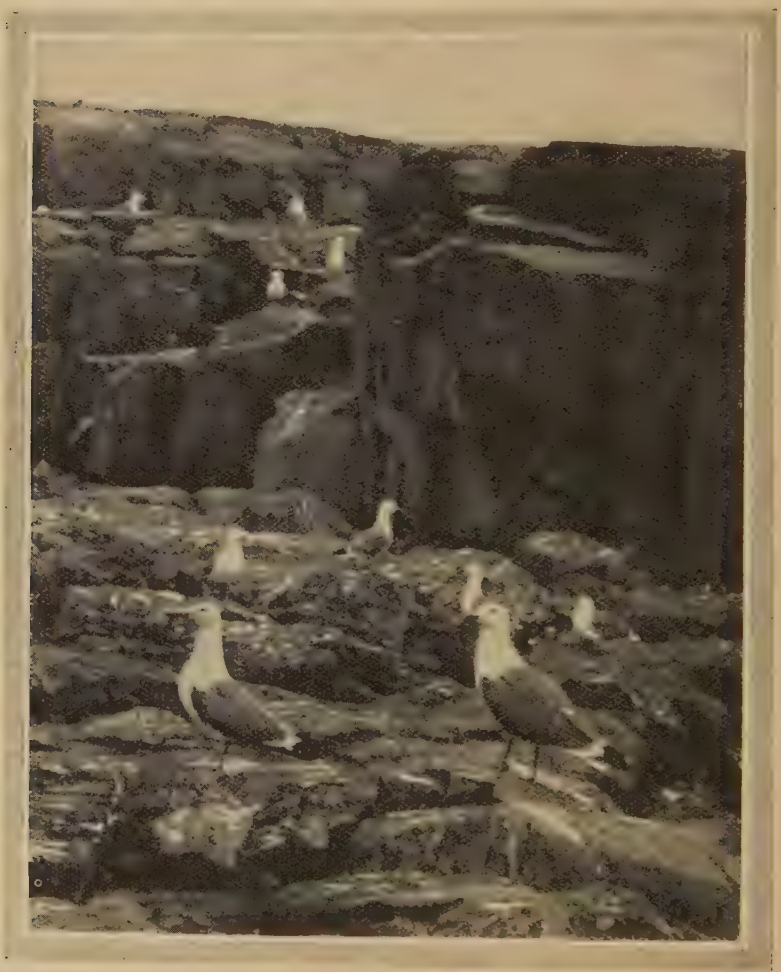
The great black back frequently constructs a large and somewhat slovenly nest of seaweed, heather, dead grass and bits of wool. The wing quills of other gulls that may have died or been killed in the neighbourhood are frequently utilized.

Two, but more generally three, eggs are laid in a clutch. In ground colour these vary from yellowish to light olive brown, blotched with dark brown and slate grey

spots. The down-clad young ones leave the nest soon after they are hatched, and wander about. It is said that they do not attain their full adult plumage until the fifth breeding season.

The lesser black-backed gull is far more numerous as a species than its relative just described. It breeds in great numbers on the Farne Islands, but nowhere south of this point on the East Coast or in the south until we come to Devon and Cornwall. It is not so numerous as the herring gull in Ireland, but so far as my experience carries me, reverses things in Scotland, where it predominates in point of numbers.

It feeds upon any kind of carrion that may happen to be thrown up by the tide; crabs, any surface swimming fish it may be lucky or dexterous enough to catch, worms and grubs turned up by the plough, the eggs and young of other birds, and frequently upon grain in the spring.



The Lesser Black Back Gull, as a species, is far more numerous than its relative the Great Black Back. It breeds in vast numbers on the Farne Islands, but nowhere south of this point on the East Coast or in the south of England until Devon and Cornwall.

In the Outer Hebrides I have watched lesser black backs, wild duck and rock doves, all hunting for stray uncovered oats in a newly-sown field. The husks of the corn are not digested by the gulls, but are cast up in "pellets" or "quids," just as owls, rooks, and other birds eject undigestible portions of anything they happen to swallow.

During the excessively hard winter of 1895 this and other members of the *laridæ* family were driven to a diet of turnips in order to maintain their existence in North Uist, and my friends tell me that the birds have kept up the practice ever since, in the absence of a plentitude of other food.

It is said that members of this species will occasionally attack human intruders upon the privacy of a breeding haunt. I have been subjected to angry demonstrations at more than one gullery, but do not

**A GRACEFUL LANDING**

**Greater Black-backed Gulls coming in from the sea**

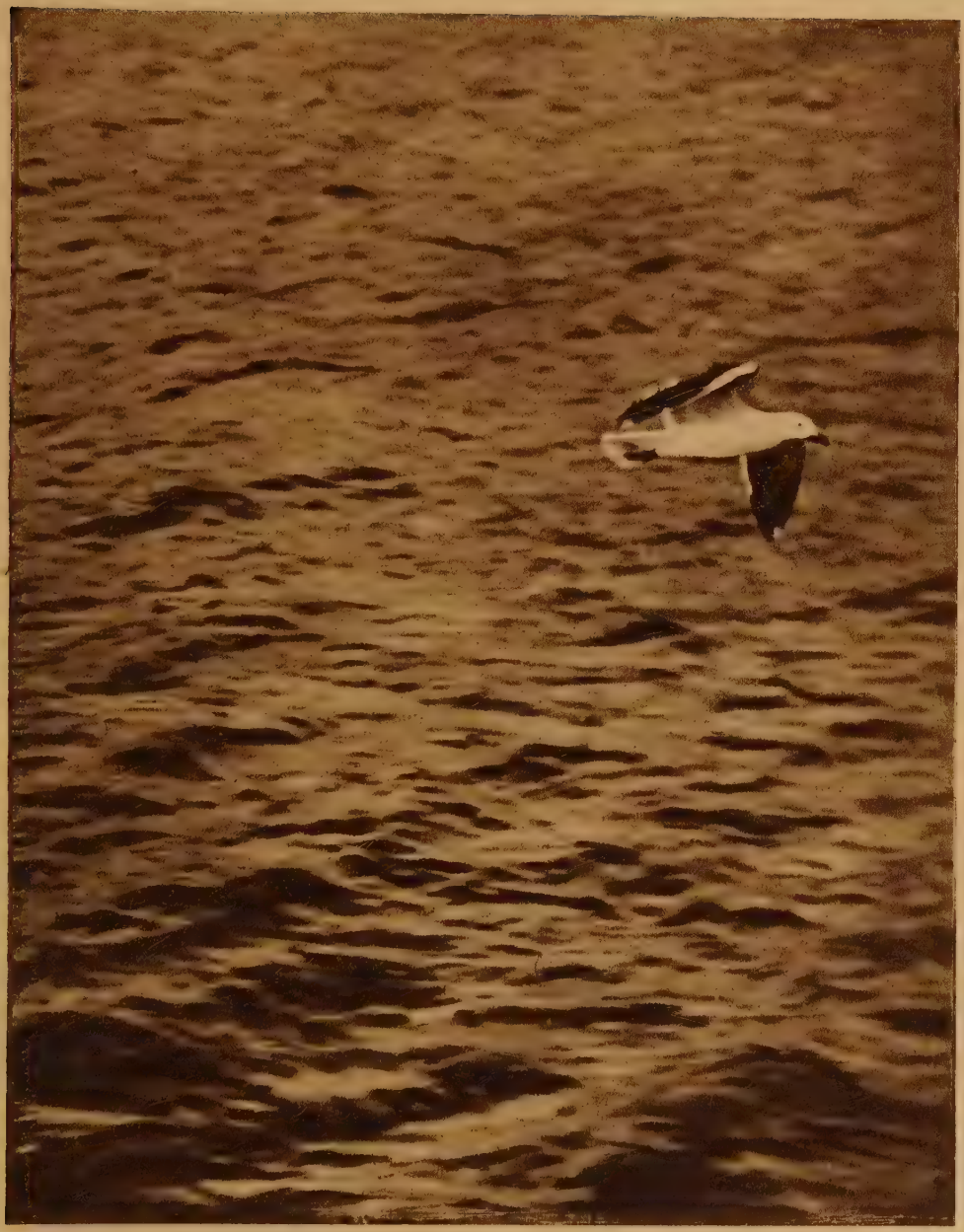
*Photograph by M. Best*

LESSER BLACK-BACKED GULL AND YOUNG, SCILLY ISLES

*Photograph by Eleanor Shiffner*

LESSER BLACK-BACKED GULL TURNING HER EGGS

*Photograph by M. Best*



THE HOMEWARD FLIGHT

Lesser Black-backed Gull on Loch Linnhe, near Fort William

*Photograph by Niall Rankin*

A STUDY IN SOLITUDE

**Lesser Black-backed Gull**

*Photograph by G. C. S. Ingram*

remember ever being actually struck by a lesser black back. Grace Darling's father, who was a lighthouse-keeper on the Farne Island, has, however, recorded the fact that "an old woman who was in the habit of gathering their eggs had her bonnet almost torn to pieces, it being perforated throughout" by the bills of infuriated lesser black-backed gulls.

The nests vary considerably in regard to the amount of material used. Sometimes quite a large structure of seaweed and green grass may be met with, whilst at others the eggs may be discovered in a hollow where the grass has been trodden down, or in an absolutely bare scrape in the peat earth.

The eggs number from two to four, but three is an average clutch. They are very variable in ground colour, from dark olive brown to pale bluish-green, spotted, blotched and streaked with ash-grey, pale brown and dark liver-brown.

A member of this species has been known to mate with a herring gull in confinement. In the offspring the mantle was paler than that of the lesser black back, but not so light as that of a herring gull.

Whilst on the Dogger Bank in the early spring, I have watched both lesser black back and herring gulls emboldened by hunger seize and carry away herrings from nets that had almost been hauled inboard.

Strange things occasionally happen in the realms of Nature. Some years ago an eider duck and lesser black-backed gull nested side by side on the Farne Islands. A visitor put the birds off, and the latter returning home first promptly devoured her neighbour's treasures. A little later on the eider duck, finding her enemy absent, took possession of her nest and its contents. I made a special journey in order to record this unique happening with my camera, but, alas! had no luck.

All kinds of carrion thrown up by the tide provide food for Lesser Black Back Gulls. Emboldened by hunger, they have been seen to carry away herrings from nets that had almost been hauled inboard.

Newly-fledged Kingfishers have the same brilliant plumage as the adults. It is retained through all seasons of the year.

# 21.—PLUMAGE, COURTSHIP AND SONG

By A. LANDSBOROUGH THOMSON, O.B.E., D.Sc.

IN thinking of decorative plumage we are apt to be prejudiced by our own human conceptions of beauty. Many birds, it is true, have plumages which we do not hesitate to describe as highly ornamental, and this is so even in the case of our northern avifauna, although brightly coloured birds are less common with us than they are in the tropics. Nevertheless, it is worth while remembering that many birds which to our eyes are but plainly garbed may be none the less attractive according to their own standards, and it is obviously these standards which have to be considered when we are discussing courtship and preferential mating. The same principle holds good with regard to bird music. At the same time we can without partiality distinguish between those birds with notable developments of either plumage or voice which are obviously ornamental in function, whether specially beautiful to us or not, and those birds possessing no very consipcuous characters of this kind.

In some birds, for instance, there are well-marked differences in plumage between the sexes, and in certain cases these may be enhanced by some special development during the b eeding season. Many of the distinguishing characters take the form of crests or tail-streamers, or are in some other way clearly ornamental rather than utilitarian in purpose. But this question of sexual and seasonal plumages is complicated by many differences in principle between one kind of bird and another.

Some birds which have a brightly-coloured plumage, as, for example, the kingfisher, wear this irrespective of sex, season or age; even the young birds new-fledged in their nest displaying the gaudy plumes. In other birds the young are of sober hue, but the adults of both sexes have a bright plumage all the year round; of this the starling, with its beautiful iridescent adult dress, is a good native example. In birds like the golden plover, on the other hand, the sexes are alike, but both cock and hen have in the summer a common nuptial plumage, in this case characterized by black underparts with a white edging between these and the greenish-gold of the upper surface. Similarly, both sexes of the well-known black-headed gull lose in winter the character from which the species takes its name.

There are other cases again in which the sexes are very distinct in appearance, the male being usually the more ornamental, as it is often the larger, of the two. The cock pheasant with its bright colouring and very long tail is thus permanently different in plumage from the plainly coloured, shorter-tailed hen. The same is true of nearly all the different species of wild duck, except that the drake has a strange period of "eclipse" in the late summer; at this time he moults with such rapidity that he is often temporarily unable to fly, and has to go into hiding, taking no part in the domestic duties, and for a short time he is a dull-coloured bird lacking the fine feathers which he carries from October to July.

In still other species the sexes are more or less alike during the winter, but the male alone has a special nuptial dress. One of the best British examples of this is the ruff, a bird of the sandpiper family in which the male in the breeding season acquires a large ornamental frill of feathers of very variable colour and pattern.

It should be added that there are also seasonal plumage changes which serve other purposes than those of ornament and courtship. On the Scottish mountains, for instance, the ptarmigan is "camouflaged" to suit the seasons, being brown on most of its more visible parts during the summer and white almost all over during the time

*Photo: Henry Willford.*

*Photo: Stanley Crook.*

In the case of the Starling the immature birds have dull colouring, but the bright iridescent plumage of the adults is worn by male and female alike irrespective of season.

*Photo: Riley Fortune, F.Z.S.*

The Ruff in winter lacks the distinctive ornament—the frill of feathers, of very variable colour and pattern, which gives him his name—developed in the breeding season.

when the ground there is usually covered with snow. There are perhaps other cases, although less obvious than this one, in which we should be cautious about adopting any theory of ornament where the changes that occur are not dependent upon sex.

When the season of courtship and mating arrives there is often much more than a mere passive wearing of brilliant plumes—there is a definite attempt to display them to the best advantage. The cock will perhaps stand in a crouching attitude before his mate, raising his crest if he has one, drooping his wings, and erecting and spreading his tail. Although a foreign bird, the peacock with his gorgeous train is perhaps to us the most familiar instance of this kind of display, and among former but now practically banished British birds the great bustard is a particularly fine example; there is a specimen of a male bustard in the extraordinary attitude of display in the Natural History Museum at South Kensington, although none, unhappily, is nowadays to be seen alive on the Sussex Downs.

Among relatively common British birds the black grouse provides one of the best examples of the habit of courtship display and combat, and the fortunate observer—say in a wooded part of the Scottish Highlands at the dawn of an early summer day—may see some such sight as was described by that great ornithologist, William Macgillivray: "Although destitute of spurs, it fights in the same manner as the domestic cock, lowering its head, erecting and spreading its tail, and leaping against its adversary, endeavouring to drive him off, and if possible tear him to pieces. The combats, however, are less bloody than those of our game-cocks, although they are engaged in with so much earnestness than an unscrupulous fowler might easily carry destruction among the gallants. A cock who has beaten off his opponents from his favourite station betakes himself to it morning and evening, and struts in a pompous manner, with spread tail and stiffened wings rustling against the ground, calls aloud with a harsh grating voice and invites the neighbouring females, or rather challenges those of his own sex within hearing to come forward and dispute his claim to the favour of his elect brides." In this species the male is known as the blackcock, and the female as the greyhen;

*Photo: Alfred Taylor.*

Kingfishers—young and old—of both sexes have the brightest plumage of any British birds.

*Photo: Riley Fortune, F.Z.S.*

The Ruffs, in summer time, gather on little mounds and engage in regular tournaments; the bill is the weapon and the "ruff" serves as a shield. The fights have the appearance of being furious, but are usually bloodless.

as these names imply, there is a very distinct sexual difference in the plumage.

The lapwing, or peewit, is a still more familiar bird which has a well-marked courtship ritual. In this the making of scrapes or "cock's nests" by the male bird plays a great part, and it appears that when a female is induced to follow the male in excavating one of these hollows she may be regarded as having accepted his suit, and it may be that this particular scrape becomes the true nest of the pair. There is also a curious approach which the courting male makes towards the female—in a crouching

*Photo: P. Webster.*

The Reeve is the female of the Ruff species. Her plumage is quite different from that of her mate and is designed for concealment rather than display.

position, with outstretched neck and flattened crest—and an attitude of display in which his tail is spread and erected. After pairing, the male also indulges in a love-flight of a playful and acrobatic nature, and during this his cry of *whee-weet* gives place to a "song," which has been syllabled *whey - willuchooee - willuch - willuch - cooee*. Combats take place between males in the air,

Photo: M. Best.

The sexes of the Golden Plover are alike in plumage, which in summer is transformed into "nuptial" attire, when the underparts become black, with a white edging between these and the greenish-gold of the upper surface.

and one male is particularly quick to resent any attempt of another to make scrapes in what he regards as his peculiar territory.

The ruff, to which we have referred, is now rather an uncommon British bird, breeding only in small numbers in the marshes of the east of England. In summer the male has the curious ornament from which it takes its name (the female being called a "reeve"), and to which allusion has already been made. Where they are found in sufficient numbers the males, which are polygamous, gather on little mounds and engage in regular tournaments; the bill is the weapon and the "ruff" serves as a shield. These combats are fought out with a great appearance of fury, but are usually harmless in their result.

A rather different kind of performance associated with the mating season is the strange love-flight of the woodcock, of which we cannot do better than quote the late Professor Newton's description: "During this season the male woodcock performs at twilight flights of a remarkable kind, repeating evening after evening (and it is believed at dawn also) precisely the same course, generally describing a triangle, the sides of which may be a quarter of a mile long or more. On these occasions the bird's appearance on the wing is quite unlike that which it presents when hurriedly flying after being flushed, and though its speed is great, the beats of the wings are steady and slow. At intervals an extraordinary sound is produced, whether from the throat of the bird, as is commonly averred, or from the plumage is uncertain. To the present writer the sound seems to defy description, though some hearers have tried to syllable it. This characteristic flight is in some parts of England called "roading," and the track taken by the bird a "cock-road." In England in former times advantage was taken of this habit to catch the simple performer in nets called "cock-shutts," which were hung between trees across the open glades or rides of a wood, and in many parts of the Continent it still is, or was till very lately, the disgraceful habit of persons calling themselves sportsmen to lie in wait and shoot the bird as he indulges in his measured love-flight."

These are but a few examples in which special habits of courtship are particularly well marked, but in almost every species these performances have some counterpart. They have been described for many British birds, ranging from the great-crested grebe down to some of the smallest warblers. Brilliant plumage is not essential, or at least not plumage which is noticeably ornamental in our eyes, for many a sober-hued little bird will go through all the motions of "display"—erected tail, drooping wings and bowing body—before the mate of his choice. Some birds are more combative

*Photo: P. Webster.*

**WOODCOCK.**

The plumage of this species is a most effective piece of "camouflage." In the mating season the male performs a remarkable love-flight, sometimes called "roading."

than others, the robin and the moorhen being familiar examples of pugnacity, and some have special weapons like the spurs of males of the " game-bird " group (which includes the domestic fowl).

There has also to be considered the part which music plays, but it would probably be a mistake to think of song as no more than the vocal aspect of courtship. Undoubtedly, however, song is most in evidence in the mating season, and is important in the musicians' wooing. It must, nevertheless, be remembered that there is recrudescence of song in the autumn—after the silence of the later summer—and that some birds, like the skylark, sing almost throughout the year. Professor Garstang, indeed, urges that birds " cultivate the pursuit of sound-combinations as an art " which " becomes to many of them a real object of life."

*Photo: T. M. Fowler.*

The ornamental crest of the Lapwing is worn by both sexes throughout the year. There is a pronounced courtship ritual, which includes many strange gestures on the part of the male.

If our native birds are on the whole less brilliantly plumaged than those of tropic lands, we have at least no reason to complain of their music, for in this they excel. Such songsters as the thrush, the blackbird, the nightingale, the blackcap, the garden-warbler, and the skylark—to name only what are perhaps our leading half-dozen—will hold their own with any in the world. All these birds with true song belong to the great natural order of the perching-birds, but outside its limits there are many others which utter sounds which may be classed in the same category as song, although they be less musical in our ears—the call of the cuckoo, say, the bubbling spring note of the curlew, or even the hoarse grunting cry of the breeding guillemot. There are sounds, too, which are not vocal, as, for instance, the " drumming " or " bleating " which the snipe makes in spring and which is caused by the vibration of the stiff outer tail-feathers during rapid downward flight.

Many birds are monogamous, and there is good ground for believing that in some cases pairing is for life. Others are polygamous like the pheasant, where one cock mates with several hens: a few go to the other extreme and are poly-androus, while the relations of cuckoos may possibly be best described as promiscuous. As a general rule the monogamous cocks take an important share in the domestic duties; they help to build the nest and to feed the young, and they either take their turn at incubation or they bring food to their sitting mates. The polygamists, on the other hand, are bad fathers; having several families they look after none. The wild ducks of various species are generally monogamous; but we have already seen that the drakes have a special reason for not taking part in the care of the eggs and the young. It may be noted also that when the mallard is domesticated by man it loses its monogamous habits in the farmyard, with many other virtues besides, and becomes a polygamist.

It is among the polygamous species that we find the best examples of males with distinctively decorative plumage and well-marked habits of courtship "display" and of combat for mates. In these cases there is a superfluity of males and the competition is greatest.

The only native example of a bird with truly polyandrous tendencies is the red-necked phalarope, a member of the sandpiper group which breeds in some of the Scottish isles. Here the female is the larger and brighter bird, and it is she who does most of the courting and fighting, while the greater part of the domestic duties fall to the share of the males. Polyandry, however, appears to be more conspicuously developed as a habit in certain other phalaropes than in our species, and in these the female, when once she has left a clutch of eggs in the care of a cock bird, appears regularly to seek out a new father for a further family. Among the birds of prey also it is common for the female to be the larger of the pair, and in the sparrow-hawk the disparity in size is very remarkable, but this fact is not associated with any peculiarity in breeding habits.

In reviewing all the facts of which this chapter gives a brief account, one gets an impression of the high degree in which are developed among birds special habits of courtship, bodily ornament, and beauty of voice. In many cases the ritual of courtship is very elaborate and must obviously be the outcome of a long evolution in which preferential mating—the choice of the most accomplished suitor—has played its part. It seems more doubtful whether the development of ornamental plumage is the result of sexual selection or whether it has not been largely brought about by the operation of other factors. There are many complications to be borne in mind. We have seen, for instance, that in some cases the bright plumes and ornaments are not the monopoly of the male. Sometimes, too, the bright nuptial dress, whether of the male or of both sexes, is worn only in the breeding season, while in other instances it persists throughout the year. As regards song, we have noted that it is more than a mere adjunct to courtship, and that in some birds it forms part of the daily life during almost the whole of the year.

*Photo: Alfred Taylor.*

As is commonly the case with the birds of prey, the male of the Sparrow-hawk is a much smaller bird than his mate.

Pied Wagtails are frequent victims of the female Cuckoo. If the Wagtail's own eggs are already advanced in incubation, the intruder will either destroy them or drive the bird away for the sole purpose of making her rebuild.

# 22.—THE WILES OF THE CUCKOO

By GEORGE J. SCHOLEY

With photographs by the Author and H. H. Turner

FOR many years I vainly endeavoured to solve the mystery of the destruction of various nests of eggs and young birds on restricted areas inhabited by female cuckoos.

Boys, snakes, vermin and jays were among the many causes I attributed to the mysterious disappearance of these nests, and it was not until the nesting season of 1921 that I had occasion to confirm a fleeting suspicion that it might be due to my old favourite the cuckoo with some ulterior motive in view. During the season of 1922 I made plans to run the mystery to earth, and was at once rewarded by the discovery of such remarkable behaviour on the part of a female cuckoo as has never before been suspected.

A week following her arrival on April 26th she made systematic tours of inspection of her territory—which comprised a chalk quarry of roughly four acres in extent—and had soon found all the nests of the pied wagtails then in course of construction. A rigid watch from sunrise to sunset during her stay revealed for the first time the fact that she deliberately and ruthlessly destroyed all the nests of pied wagtails' eggs which were too far advanced in incubation to allow of her own egg being hatched with the wagtails.

On every occasion where I found she had purposely destroyed the nests of eggs and young birds of her natural fosterers it was proved beyond doubt that such behaviour was performed for the sole

purpose of driving the wagtails to rebuild, and so have fresh nests ready for the depositing of her own eggs on equal terms with those of her fosterers. Throughout the season she created her own facilities for the successful deposit of her eggs at the right and proper times, a very notable case being that in which she found a nest of incubated wagtail's eggs which she could not destroy by reason of the entrance hole to the nest being so restricted. She, however, remained at the entrance and frustrated all efforts of the wagtails to enter, with the result that the eggs got cold and the wagtails deserted. A new nest was immediately proceeded with, which received her egg a week later; and so the game went on throughout the season. Where there were two nests of her natural fosterer on her territory in the same condition—say, each containing four fresh eggs—she would deposit her own egg in one to-day and return a few hours later to remove an egg from the remaining nest. This, of course, induced the wagtail to lay a further egg and so have the nest ready for the cuckoo when she came to deposit her own egg two days later.

She laid fourteen eggs during her stay, proving faithful to the wagtails throughout. The eggs were laid in three relays with forty-eight-hour intervals between each egg, and she always found the nests of her intended victims at least two days previous to using them. She laid her first egg on May 14th and her last on July 5th, and on each occasion she removed an egg of the fosterer when depositing her own.

Following the laying of her last egg on July 5th, she was not seen again until July 19th (exactly an incubation period). When she returned to the quarry on this evening she visited most of the places where she had deposited eggs, and I have seriously wondered whether she could possibly have been endeavouring to ascertain the results of her season's work. She gave another look round the following morning, and we were all sorry when we saw her fly off for what proved to be the last time that season—July 20th, 1922.

A female Cuckoo on a raiding expedition. She is investigating the nesting-hole of a Pied Wagtail, for the purpose of destroying the eggs.

*Photo: J. T. Newman.*

Discarding the usual habits of his kind, a Blackbird thought fit to have a roof to its dwelling, and built its nest inside an old tin bucket at the bottom of a chalk-pit in the Chilterns.

# 23.—SOME QUEER NESTING-PLACES

By J. T. NEWMAN

BIRDS are not automata, and no more than human beings will they regulate their ways altogether by prescribed rules. The love of adventure and experiment seems to be an instinct that crops up here and there, not only in man but throughout the whole animal kingdom. Indeed, if it did not, the forms of life on the earth would be considerably less varied than they are to-day; for what the first adventurous couple will do driven either by necessity or by mere taste for experiment, may easily become a racial habit, and so tend to change or modify not only the general ways but even the structure of the species.

To the naturalist, however, eccentricity is always a little disconcerting. No sooner does he establish some law accounting for the behaviour of this or that species, than some individual pair will surely defy it and behave in an altogether outrageous and unexpected way. The strange sites, for instance, that birds will sometimes choose for their nests are really puzzling, and during the past thirty years many such curious examples have come under my personal observation.

Doubtless because it is fond of human society, and nests, when permitted, near or even in the house, it is the robin that has supplied most examples in this direction for my camera. Once, I remember, a bowler hat that had been hung as a scarecrow over the seed-bed was boldly appropriated by a pair of these birds. Seeing the robins so much at home, other birds gathered round, thus making a great joke of the gardener's effort, for instead of a warning, the old hat served, of course, as a decoy. Eventually the whole thing was removed to another site where, left in peace, the robins successfully reared their family.

On removing a watering-can from a nail in the greenhouse, where it had hung all the winter, a friend of mine was once startled by the sudden escape of a robin. Inside, snug and dry, were nest and eggs! He

*Photo: J. T. Newman.*

In a wire basket suspended from a nail in a dark shed, a pair of Wrens essayed the laborious task of making a home. All the materials—long straws almost equalling the bird's own weight—had to be drawn through the small meshes of the wire-work.

replaced the can and gave orders that it was not to be used until the birds had finished with it, and, thanks to his consideration, this family also lived to fly out into the world. I have seen robins nesting in sheds and workshops within a few feet of the workmen, quite untroubled by all that was going on. Once I found a pair ensconced in a battered tin kettle—almost dropping to pieces and not even waterproof—and another nest was found in a coffee-pot with entrance so small that the birds could hardly pass out. It was fortunate for the family that the spout could serve as ventilator! Tin receptacles of all kinds lying about in the nettles make excellent nesting sites as they are dome-shaped and weather-proof.

The wren is a more shy bird than the robin, but a pair that I once knew chose a strange home in a wire basket that hung on a nail in a dark shed. The building of the nest must have been a laborious task, seeing that all the materials—long straws almost equalling the bird's own weight—had to be drawn through the small meshes of the wire. But a cosy home was constructed, and the presence of the workmen seemed to disturb them not at all. Wrens are, next to the gold-crest, the smallest of British birds, and are so dainty and charming that one would imagine they must be beloved by all. Yet such is the strength of superstition that in

*Photo: J. T. Newman.*

A Swallow's nest on a chestnut branch some ten feet from the ground is unique. Swallows had been known for generations to nest in an adjoining barn, but never in this tree. Yarrell states that a Swallow built in a sycamore.

*Photo: M. H. Crawford.*

Robins sometimes choose odd nesting-places. A flower pot lying on its side, a battered tin can, an old coffee-pot, and many other receptacles have served on occasion.

olden times this harmless little bird was hunted to death, and that during the Christmas season! Legend tells us that when St. Stephen was on the point of escaping from prison, a wren flew in the face of the gaoler and woke him—thus detaining the saint for his martyrdom. In some parts —notably the Isle of Man—wren hunting was a feature of the season between Christmas and the New Year; processions were held, and mock services were carried out over the bodies of the victims.

The wren's nest is an exquisite structure, built usually in a low bush or a bank dome-shaped, with a hole near the upper part just large enough to allow the bird to enter; it is composed of moss and leaves and warmly lined with feathers. Inside are the tiny eggs—each no bigger than a cherry-stone, white with a few red spots, and six or eight in number. Like most eggs that are laid under shelter, they are very fragile and easily crushed by a too clumsy finger. I have known many wren families in my garden, and noticed that after they leave the nest they gather together every evening and roost among the ivy on an old oak tree. One season some wrens, having outgrown their own, took possession of the abandoned nest of a greenfinch, and there I watched them many times. So tame were they that I was allowed to peer within a foot of them. Did I but touch the leaves, however, they would scatter in all directions, returning only in answer to the call of the parents.

A swallow's nest on the branch of a chestnut was indeed a curiosity, and one I travelled many miles to see. It stood overlooking the Thames, a fine situation with wide views over the surrounding country. Swallows had been known to nest in an adjoining barn for generations, but never before had they built in this tree. It was on a branch ten feet or so above the ground, swaying in the breeze, while the parents came and went, busy with their task of feeding the four young birds. It was a difficult position to photograph, but the farmer kindly brought out a large Oxfordshire wain, and from this elevation the picture was secured.

I much wished to photograph the birds in the act of feeding the young, and waited a long time for this purpose, but although the old birds came and flew around, so swiftly did they move that it was impossible to catch them. No doubt the unusual proceedings and the sight of the camera had thoroughly upset them. Thus I had to be content with the picture reproduced on page 485, which, however, is unique so far as my experience goes.

Swallows are particularly fond of farm buildings; the wide old wooden beams afford such a good site for the nests, while food in the shape of flies is always at hand. They will also build inside the big old-fashioned chimneys—in spite of smoke and soot! In the country they are supposed to bring good luck, and I well remember my mother's injunction to the sweep—not to knock down the nest. Nevertheless, it would often happen that parts of the nest came tumbling down into the wide chimney nook where great logs crackled on the hearth.

The blackbird's is the most easily found of all nests, as it is so often placed in the hedgerows when they are bare of leaves. They are untidy erections, looked at from the outside, but inside, a layer of mud keeps the wind away, and an inner lining of fine grass makes all snug and homelike. Here, however, is a strange freak on the part of a blackbird. At the bottom of a chalk-pit in the Chiltern Hills lies an old bucket, and discarding all his customary habits, with bushes and hedgerows in abundance near at hand, this particular bird thought fit to have a roof to his dwelling, and built his nest inside. Had broken buckets been more in the order of nature, possibly he might have instructed his young in their use, and been the founder of a wholly new bucket-building line of birds. Fortunately for the landscape, however, blackbirds are more common than buckets, and so the majority keep to conventional hedge-building ways.

Another curious nest I found, some two miles away from the last, seemed to show a

*Photo: M. H. Crawford.*

The Robin sitting on the nest in the flower-pot, which evidently made a comfortable as well as a weather-proof, well-ventilated shelter.

love of decoration on the part of the blackbird, for it is not easy to see what other use can have been intended by collecting these paper streamers. They were woven into the outside, so were not gathered for warmth or softness, nor could any intelligent bird have used them for strength. Indeed, though woven well into the fabric, the long streamers fluttered in the breeze and effectually advertised the whereabouts of the nest, so that in this case the love of show had evidently got the better of the bird's natural caution.

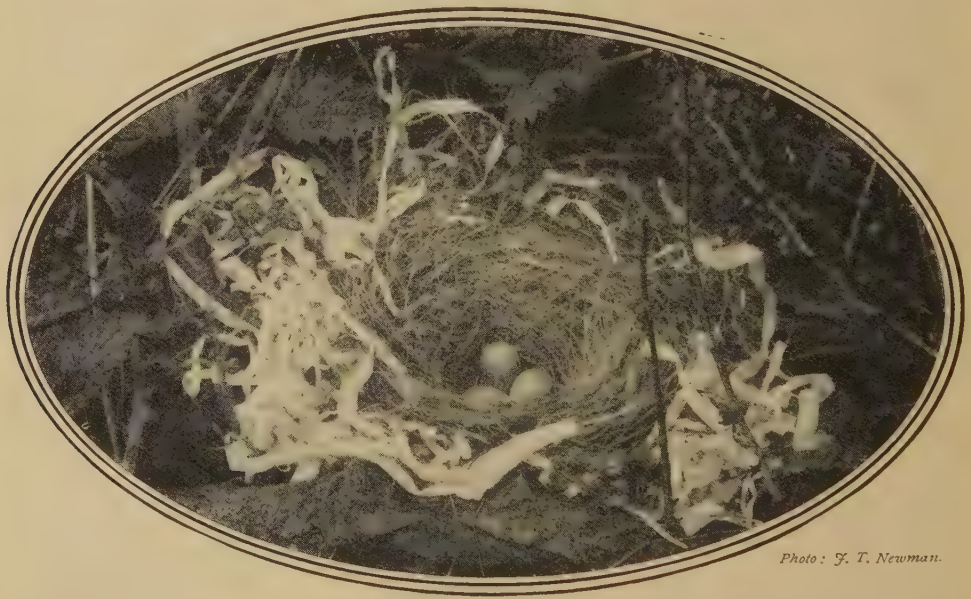


*Photo: F. T. Newman.*

A Blackbird's nest festooned with paper is surely a novelty. It is difficult to understand for what purpose, other than that of a love of show, the unusual material was conveyed for a long distance, and used in this curious fashion.

The next photograph shows a song-thrush's nest in a basket. It was in a large orchard, and here again there were plenty of the conventional building sites near by, yet for some reason the bird selected the basket, with such a large space to fill up that it required a vast amount of material before the nest could be completed. Perhaps the bird considered that the extra cosiness of the basket made up for the extra labour, or perhaps again the mere distinction of possessing something a little out of the ordinary was sufficient compensation.

I came upon much the same thing in the case of a jackdaw's nest that I once photographed. It was built high up in a round tower, one side of which formed the side of the cup holding the eggs. The rest of the floor space was completely filled with sticks, over a hundredweight having been carried up by these indefatigable birds. All this enormous labour was wasted, too, for the tower was a show-place, and the nest had to be cleared away by the caretaker. The persistent jackdaws, however, kept her busy; for every morning before she was up they would carry in fresh sticks, determined not to be ousted. But the caretaker won in the end, and the birds were compelled to resort to their usual habits and build outside in some hollow tree.

The wild ducks who built in the top of a pollard willow had very good reason for departing from their usual ways, for the banks of the Thames at that particular part of Buckinghamshire were infested with rats. In this tree-top was a wide open space lined with dead-wood, and here the bird had scooped out a hollow and laid her ten eggs. Unfortunately, it was impossible to photograph them, nor did I observe the young when they left the nest. I was told, however, that at the call of the old bird they came tumbling down into the stream, and were none the worse for their ten-foot drop.

*Photo: F. I. Newman.*

**NEST OF A SONG THRUSH IN A BASKET.**

The orchard was surrounded by many conventional sites, but perhaps the bird considered that the extra cosiness of the basket compensated for the additional labour of filling up such a vast space.

*Photo: J. T. Newman.*

A Wild Duck's nest in the top of a pollard willow, a situation which provided a wide hollow lined with dead-wood, and, incidentally, afforded protection from rats.

They must have made a pretty picture as they swam off up-stream, little balls of fluff bobbing about on the water, swimming and diving in their own familiar element. The wild duck is a careful mother, very solicitous for her brood, and keeps them with her until late in the summer, when they are scattered by the guns.

*Photo: J. T. Newman.*

An overturned disused water-tank on a river-bank was adopted by water-hens as a nesting site, which was at once curious and unique.

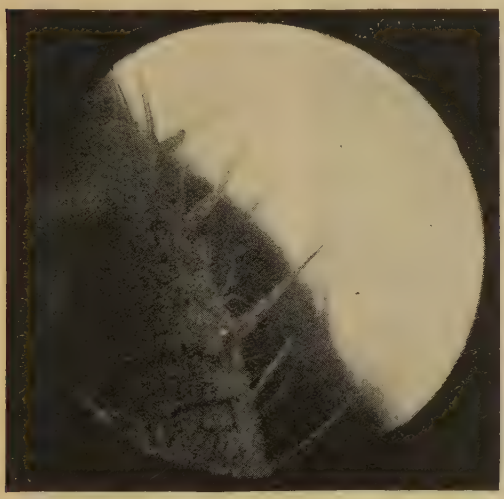
# Nature Under the Microscope

## 1.—HOW THE NETTLE AND THE WASP USE THEIR STINGS

By A. HAROLD BASTIN

With photographs by the Author

THAT mankind invented the poisoned dart and the hypodermic syringe is beyond question; but is it not equally certain that Dame Nature knew



When examined under the microscope the so-called "stings" of the common Nettle are seen to be highly specialized "hairs," which stand out in great numbers from the leaves and stems. Each hair is a large, single "cell." (*Greatly magnified.*)

all about the principles involved in these contrivances long before man had developed a brain capable of inventing anything whatever? To prove this contention it seems only necessary to point to the "stings" with which various plants and animals are equipped as a means of defence against their enemies. We may consider first the nettle family, of which our two native species (*Urtica dioica* and *U. urens*—the "great" and the "small" nettles respectively, both common weeds) are at once the best known and the least baneful members. Everyone is aware that nettles "sting"—that is to say, set up a painful burning sensation, or inflammation, in the flesh that is brought into contact with their leaves or stems. Many people know, too, that if a nettle is grasped *boldly*, and held *tightly*, its stinging propensities do not come into play; while a few intrepid spirits have made the discovery that if a nettle's leaf is gently stroked in a particular way, no harm to the hand

The formidable stinging hairs of the common Nettle. Nature, unlike civilized man, does not bar poison-tipped darts and the like. The hairs are easily broken off at the tips, and when they penetrate the soft flesh of an animal the poison (which is contained in the swollen base of the hair) enters the wound.

results. If we are to understand the "why and wherefore" of these facts, we must investigate the structure of the nettle's stings, and learn how they work. This can be done without much difficulty with the aid of the microscope, or even of a fairly powerful pocket lens.

When thus examined, the so-called "stings" of the nettle are seen to be specialized "hairs," which stand out in great numbers from the leaves and stems. Each hair is a large, single "cell," or living unit of the plant's tissues, highly modified for the special end in view. It is hollow, has a hard, brittle wall, and expands at its base into a club-like swelling, which is wedged among the ordinary small cells of the leaf's surface. In this swelling is the "nucleus," or seat of control, of the cell, embedded in protoplasm — the transparent, viscid substance which has been termed the "vehicle of life." This living substance, which lines the inner wall of the cell, exhibits an active, streaming movement, and on occasion may send out strands which bridge the cell from one side to the other. It also excretes the poisons contained in solution in the clear liquid which fills the space in the cell unoccupied by the protoplasm.

In this illustration of the stinging apparatus of a wasp (from a model) is seen the "poison-bag," communicating by means of its tube with the back part of the (hollow) sheath, or "director," of the sting, which is worked by a set of powerful muscles attached to six hardened plates. There are two palpi, or "feelers," which work in intimate connexion with the sting. All the parts seen against a dark background are normally hidden from view in the wasp's body.

We have, then, numbers of these glassy, poison-containing "stings" or "hairs" standing out from the surface of the leaf. Precisely how do they work? If we magnify the free end of a stinging-hair very highly, we shall discover that it does not come to a sharp point, but, on the contrary, ends in a miniature knob. Just below this knob there is a "line of weakness," which encircles the hair obliquely—the cell-wall along this line being much thinner than elsewhere. When the hair is pressed from above, however slightly, the tiny knobbed head is broken off, and the sharp edges formed at the place of rupture penetrate the body causing the pressure—if this is sufficiently soft. Moreover, the cell-wall of the club-like swelling at the base of the stinging-hair is not hardened like the rest, but remains somewhat elastic. Hence, when the splintered end of the hair begins to penetrate the flesh in the manner just described, the club-like swelling yields to the pressure, with the result that the fluid contents of the hair are injected into the wound. The resemblance to the working of a hypodermic syringe is almost complete; only, in the case of the nettle sting, the action is entirely automatic (as we say), and in no way depends upon the "volition" of the plant, regarded as the operator.

When a would-be practical joker asserts (quite truthfully) that "nettles do not sting *this month*," and then, by boldly grasping one of the plants, proceeds to demonstrate that nettles do not sting *him* this month, his obvious immunity is due to the fact that his sudden, rough handling beats down and crushes the leaf-hairs before their delicate mechanism can come into play. The hairs only sting when

they are pressed *gently*, and *from above*. Gentle pressure from the side causes them to lie close to the leaf surface; and when the pressure is removed they spring erect again. A knowledge of this fact makes possible the trick of stroking a nettle leaf without injury to the fingers. The lower surface of a leaf (which has no stinging-hairs) is supported by one hand while the fingers of the other hand are then passed *from below upwards* over the upper surface. This may be done again and again with perfect impunity, although the slightest touch falling from above upon the hairs results in a sting.

Nettles support several kinds of insects, notably the prickly caterpillars of the small tortoiseshell and peacock butterflies, which (when numerous) inflict considerable damage upon the leafage; but the stinging-hairs prove an effective safeguard against the more serious attacks of grazing animals, which are careful to keep their tender lips and nostrils from contact with these plants. In this connexion it is a noteworthy fact that certain plants which are *not* nettles nevertheless *look like* nettles. The late Lord Avebury appears to have been the first observer to record this resemblance, and it was he who suggested that the non-stinging plants may benefit by it in accordance with the well-known theory of "mimicry."

Chemical examination of the fluid contained in the nettle's stinging-hairs has shown that one of the ingredients is formic acid—the same irritant which plays a part in the stinging of wasps, bees and ants. This formic acid accounts for the "burning" sensation felt immediately after the puncture; but the succeeding and more lasting symptoms are caused by a special albuminous poison—present in the fluid in minute quantities—which is chemically allied to the poison of adders and other venomous snakes.

The analogy between the stinging-hairs of the nettle and the poison-fangs of the snake is not difficult to trace; while the agreement is even more marked and obvious in the "nettle-hairs" of certain caterpillars—those, for example, of our common brown-tail moth—which are hollow, brittle and filled with a poisonous fluid. In these latter instances the hairs do not end in knobs, but are sharply pointed. When the caterpillars are touched (especially by children, and others whose skin is unusually delicate) the hairs penetrate the flesh in large numbers, break off, and give rise to an irritating rash. It is noteworthy that these stinging caterpillars are avoided by most birds, although the cuckoo appears to eat them with impunity.

Of all the poison-injecting mechanisms devised by nature none are so complex as the stings of wasps, bees and ants. These weapons are not "automatic" in their action, but are subject to a definite nervous control. They vary considerably in the details of their structure; but, if we examine the weapon of the common wasp and its attachments, we shall gain a good general knowledge of the essential characters of the sting and how it works. Unquestionably the investigation is best begun by boldly opening the abdomen of a newly dead wasp (using a pair of finely pointed scissors) and teasing out the whole stinging apparatus with a needle in a watch-glass of water. This done, we shall find that our trophy consists of (1) the poison reservoir or bag, to which are attached the poison-glands, and (2) a muscular mass from which protrudes the sting proper, with its pair of palpi or "feelers." The muscles, together with six hardened plates which they enwrap, and to which they are attached at various points, supply the "power" and "leverage" by which the sting is actuated; but their movements are far too complicated to be described in detail here.

Enormously magnified photograph of *one* of the *two* darts or "needles" which with the so-called "director" go to make up a wasp's sting.

The sting proper, which can be withdrawn or protruded from the tip of the abdomen at pleasure, consists of a grooved

and pointed sheath (the " director ") within and along which slide a pair of barbed darts or " needles." This is flanked by the palpi, which are used to ascertain the most vulnerable point of attack. The first thrust is administered by the director, which serves to open up a wound, and to guide the needles. The latter then strike alternately with a rapid, plunging movement, and are thus driven yet deeper into the flesh, beyond the director's tip. The extreme delicacy of the needles will be appreciated when reference is made to the

The point of a Wasp's sting (left) contrasted with that of a *fine* sewing-needle. Yet the Wasp's sting is not solid. On the contrary, it is a kind of sheath containing *two* barbed darts which are used to tear the flesh, the while poison flows into the wound that is made.

accompanying photograph, in which the " business end " of a wasp's director (within which the two needles slide) is shown side by side with an ordinary " fine " sewing-needle from a lady's work-basket.

The manner in which the poison passes from the reservoir into the wound is well described by Mr. O. H. Latter in the following passage quoted from his little book, *Bees and Wasps*. " The two concave inner-faces of the ' needles ' are pressed firmly against each other, partly by the tapering sides of the ' director ' and partly by the course imparted to them by the muscles, and so form a closed tube between them. Down this tube the poison is driven by the contraction of the muscular walls of the bag in which the poison is stored. Near its front (or inward) end each ' needle ' bears an enlargement, whose surface is covered with numerous fine scales like those of a fish ; when, during the protrusion of the ' needles ,' these enlargements reach the narrower part of the ' director ' they probably act as pistons and sweep the poison along towards the hinder pointed extremity." The poison escapes from between the " needles " at their tips, as well as through minute canals which pass behind each of the first five barbs.

As in the case of the nettle, so among insects we find that formic acid is introduced into the wound along with a subtle paralysing poison. Sir Ray Lankester has pointed out that the acid produces intense pain and irritation, while the more dangerous nerve-poison does not. It is noteworthy that the presence of barbs on the " needles " of wasps' and bees' stings, while they render the sting more effective as a weapon, tend to make its withdrawal from the wound difficult—sometimes impossible. The hive-bee, for example, frequently leaves her weapon sticking in the wound, and suffers a fatal rupture in her efforts to withdraw it—a remarkable sacrifice of the individual for the benefit of the community! Mr. Cowan tells us that if time be allowed the bee *can* withdraw her sting by a spiral movement, similar to that used in drawing a corkscrew out of a cork ; but both performer and victim are usually far too much agitated to render this slow operation possible. The sting, by the way, among insects, is exclusively a feminine organ, being a modification of the egg-laying apparatus or ovipositor. In the unsexed or " worker " classes of social species it functions as a weapon pure and simple ; while in the " queens," or fertile females, the eggs pass not through the organ itself, but through an aperture at its base.

Some few of our smaller British ants have stings ; but the large ants of our fir woods have no stinging apparatus, although they are able to eject formic acid from the tip of the abdomen into a wound which they have first made by biting.

It is an interesting fact that stinging insects are often " mimicked " by insects which have no stings—just as stinging nettles seem to be " mimicked " by harmless plants.

# Strange Facts of Fish Life

## 4.—A SALMON SCALE

By DR. FRANCIS WARD, F.Z.S.

IT was on the banks of a noted salmon river.

On the shingle, a few yards from the water's edge, lay a dead fish. The work

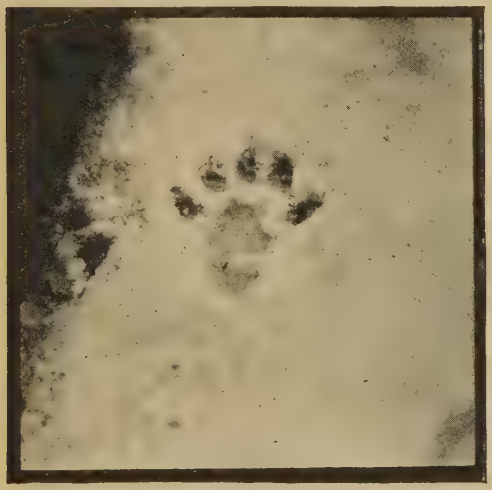


*Photo: Dr. Francis Ward, F.Z.S.*

The tell-tale footprints or "seal" of the Otter, which can always be recognized by the five-toed impression.

of an otter, for the tell-tale footprints or "seal" of this fisherman were impressed on the sand near by. The five-toed impression of this beast can always be recognized. In the case of dogs or other animals, likely to stray by the river side, the fifth claw has been drawn up and only four toe-marks are shown.

An angler, more interested in fish than fishing, found this salmon. He took a pair of blunt pointed forceps from his waistcoat pocket and pulled out a scale or two from the shoulder, with the intention of reading the life history of the fish on his return home.

For those that have never examined a salmon scale, let me say that scales consist of plates, which are partially buried in pockets in the skin. These scales overlap each other in the same manner as tiles on the roof of a house; the free edge being towards the tail.

The number of scales on a fish remain the same throughout life, and as the fish grows in size the scales grow in proportion. The increase in the size of a scale is by rings of growth round the edge, so that the buried part has an appearance similar to the section of a tree.

The variation in the width of these rings enables one to read the life history of the salmon.

During the summer, when food is plentiful, the salmon grows rapidly, the scales grow at a proportionate rate, so each ring is broad, and in consequence the summer

*Photo: Dr. Francis Ward, F.Z.S.*

A Salmon Alevin attached to its yolk-sac, whence it draws its nourishment for five or six weeks. The liver, of deep salmon pink, is represented as a dark mass on the upper side of the yolk-sac. On the right, the round object is an illustration of an egg containing an unhatched embryo.

growth is shown as a broad, light crescentic band, the rings being far apart. During the winter the growth of the fish is retarded, so each ring on the scale is narrow, and the winter growth is shown as a narrow, dark crescentic band, as there is so little interval between the rings of growth. In this way it is possible to read the age of a fish by the arrangement of the rings of growth on its scales. Now let us read the life history of the salmon found on the shingle. In 1917 a female had " run " up from the sea, found a mate and spawned. Salmon " run "—that is, ascend into fresh water—during every month in the year, but they mostly go up in February and March, June and July, and in the autumn.

Salmon are very persistent in their attempts to overcome obstacles on their way to the spawning grounds, and, given a sufficient volume of water, it is extraordinary what a raging current they can swim against. When travelling, fish often leap over considerable barriers, but a clear drop of five feet will stop the strongest. Fish often leap into the air from the pool in which they are resting. Watch how a salmon leaves the water, sometimes straight up, to fall back with a resounding splash, at other times with a quick turn he cleaves the surface with his head.

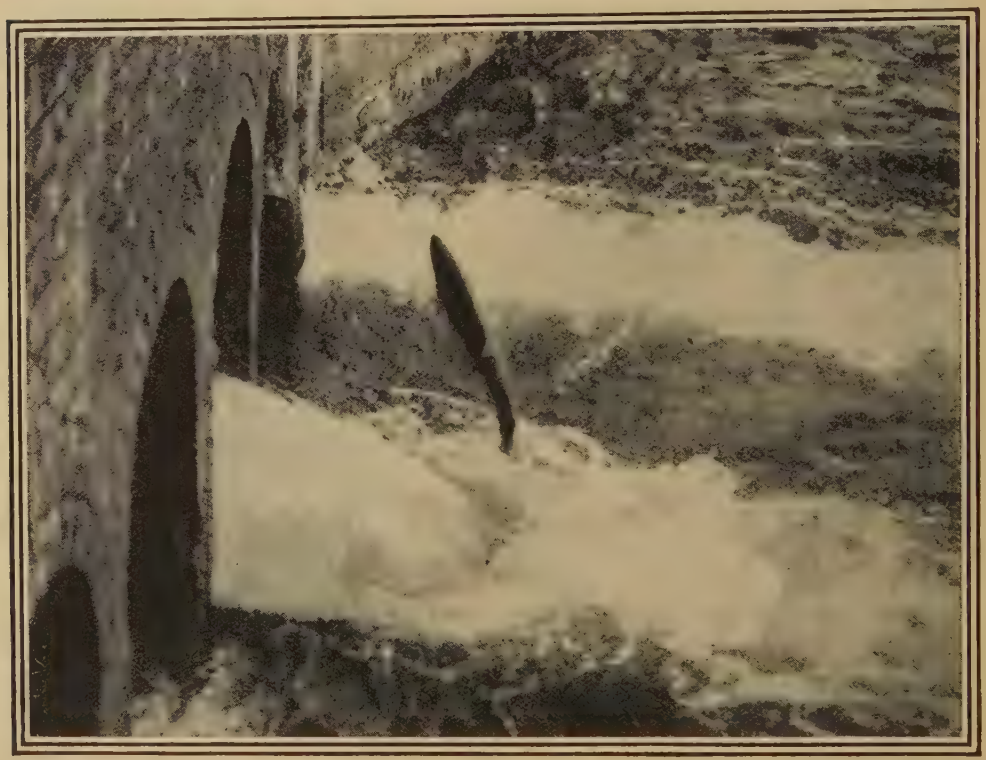


*Photo: W. Dennis Moss, Cirencester.*

A Salmon, on the way to the spawning ground, can swim against a raging current with extraordinary success. This fish is leaping the weir on the Test at Romsey.

With a clean run fish, this leaping is probably due to an attempt to clear himself of sea-lice. Later, when these parasites have dropped off, it is difficult to explain the reason for his gymnastic feats, unless it be the fact that he is uncomfortable in fresh water.

To return to our scale. About February, 1918, ova that had been buried in the gravel in the autumn of 1917 hatched. In " The Pageant of Nature," pp. 402-5, I have already described the spawning, hatching, and early life of the brown trout. The trout and the salmon are both salmonoids,

*Photo: D. Wilson, Kirkcaldy.*

**SALMON LEAPING THE FALLS OF TUMMEL, PITLOCHRY.**

When travelling, fish often leap over considerable obstacles, but a clear drop of five feet will stop the strongest.

and their early life history is similar, so let us start with the salmon "alevin."

The "centre" of the scale represents its original form on this little fish. During 1918–19 this salmon parr remained in the river. Note the tiny rings of growth during his fresh-water existence.

Salmon parr dart about in our rivers with brown trout. Many a parr is killed through ignorance. This is a pity; for this youngster has but to go to sea, avoid enemies, and return in two or three years as a heavy handsome fish.

To distinguish the salmonoid in our

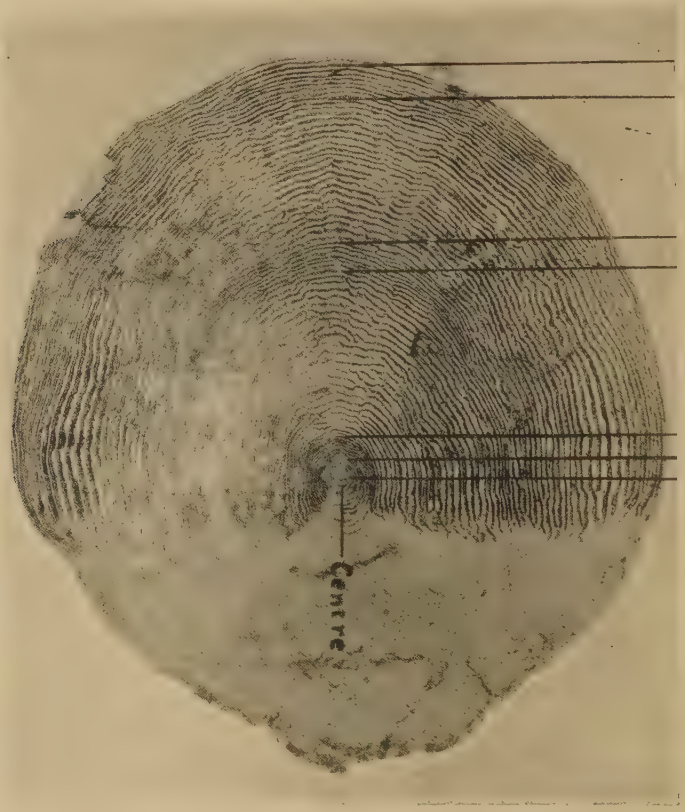

Spring growth, 1922.
Winter growth, 1921.
Summer growth, 1921.
Winter growth, 1920.
Summer growth in sea, 1920.
2nd year as Parr, 1919.
1st year as Parr, 1918.
Portion of the scale that is exposed, and is visible on the body of the fish.
Centre

*Photo: Dr. Francis Ward, F.Z.S.*

LIFE OF A SALMON AS READ BY A SCALE.
(*Magnified twelve times.*)

If the scale of a smolt taken in fresh water on its way to the sea be examined, about twenty-six of these rings will be found to be present.

The growth of the young fish during its life in fresh water as a parr is slight, so the rings are very narrow, though the difference between summer and winter growth can be easily recognized.

In 1920 the parr became a "smolt." The parr can be mistaken for a brown trout, but not the smolt, for he becomes a silvery fish, with a back of dark blue hue. He has put on his "sea-jacket."

fresh waters it must be known that in young salmon the head is shorter than in the brown trout. There are nine or ten finger-marks across the body, and the *adipose fin* is slaty blue in colour.*

The sea trout has the same number of markings, but the *adipose fin is orange tipped.*

In the brown trout there are usually only six or seven finger-marks, and the *adipose fin is red in colour.*

When the smolt passed down into tidal

* The small fatty fin behind the large fin on the back.

waters the result of his immediate growth in these waters, outside the narrow rings of his parr life, is indicated by two or three broad rings. These broad rings are formed in consequence of the immediate rapid increase in size of the smolt as a result of his more abundant food supply.

One more weary winter, and he decided to return to the place of his birth. This, of course, raises the question: Do salmon return to the river in which they were hatched?

The examination of marked fish points to the fact that salmon, as a rule, do return

*Photo: Dr. Francis Ward, F.Z.S.*

Greatly magnified section of the Salmon scale, showing the centre which marks the fish's first year as a parr, and its subsequent growth in the sea, to the end of its third summer.

During his first year in the sea the fish continues to add broad rings of growth, which gradually approximate each other as the winter approaches, and this process is repeated year by year so long as the salmon remains in the sea.

The scale next shows that our fish during the summer of 1920 fed to his heart's content; look at the size of the rings of growth.

During the winter of 1920–21 he was obviously on low diet. But in the spring and summer of 1921 he was back again on a good menu, though his feeding ground was not so satisfactory as in the previous year.

to the river from which they originally came; this is because these fish do not roam far into the sea. When the time comes round for them to spawn, the river from which they have descended is probably the nearest fresh water.

It is also possible to tell at what age a fish returned to fresh water to spawn. This is shown by a scar or spawning mark on the scale, which takes the same crescentic shape as the rings of growth.

The spawning mark is formed in consequence of the fact that when a fish has spawned it loses weight and its skin shrinks, but the scales cannot shrink, and so the

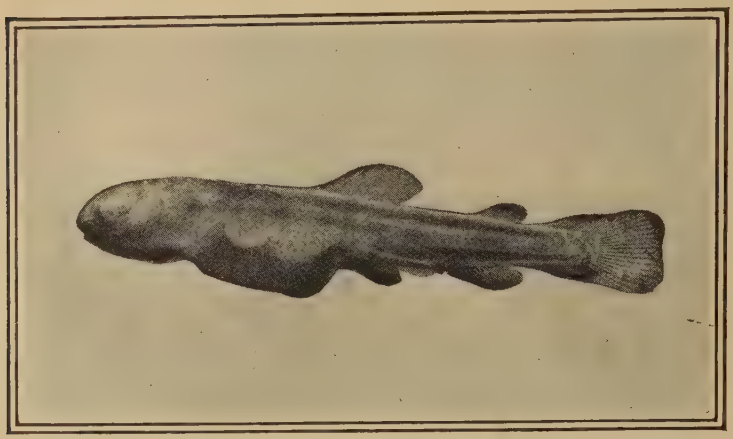


*Photo: Dr. Francis Ward, F.Z.S.*

The Salmon Alevin at the end of six weeks after hatching loses its yolk-sac and becomes a "Fry." By the autumn the fry has increased to a length of some three inches—

Thousands of fish have been examined in fresh water, and have been found to contain no food in the stomach or any evidence of digested food in the alimentary tract.

Further, after a fish has been in fresh water for some time, the lining of the stomach is in a crinkled, contracted state, conclusively showing that food has not been taken for some considerable time.

edges fray. When the scale again grows the frayed edge leaves a permanent scar.

Salmon seldom spawn more than twice in their lives, and they have not, up to the present, been found to return after eight or nine years of age. Either salmon do not spawn after this age, and, therefore, do not return to fresh water, or eight or nine years is their natural span of life.

An article on the salmon would be incomplete without an attempt to answer that oft-repeated question: "Do salmon feed in fresh water?" Fresh run fish do not. "Kelts"—fish that have spawned—most certainly do.

But the kelt, "a well-mended kelt," even after a long sojourn in fresh water, is often in such a "pink of condition" that it is impossible to think that the fish has not fed.

In consequence of the systematic marking of smolts and other stages of the salmon during recent years by attaching silver plates or wire to the dorsal fin much valuable information concerning the life history of the fish has been secured. But even now it is only partially known, and there is still much to be learnt of that period of the salmon's life which is passed in the sea.

*Photo: Dr. Francis Ward, F.Z.S.*

—And is then known as a Parr. Salmon Parr dart about our rivers with brown trout, and are often killed in ignorance of their identification. These little fish, when two or three inches in length, are brilliantly coloured.

*Photo: A. M. C. Nichol.*

When the babies were all satisfied the Willow Wren sat on the bramble-bough and went on with his plaintive little song.

# VI.—Good-bye to Spring

IT was a lovely morning in June; not a cloud in the sky, and only the gentlest of warm breezes stirring the reeds. All the wild things had been up and about since early dawn, hunting, breakfasting, singing and chattering, and seeing to their own domestic affairs. Now there was a hush throughout the land as if all were weary with the strenuous morning's work.

Even Spring—that hard-worked fairy, was tired that morning. Her busiest time was over. The year now was fully awake, and everything was growing and flowering and nesting and mating in the full tide of life.

So she came down through the reeds to the river and sat down by the water-lilies where a little furry, round-nosed water-vole was also sitting enjoying the quiet June sunshine.

To the river, too, came the children, chattering down the winding pathway. On hearing them, the vole slipped quietly into the water, but Spring for once was not in a hurry, and let them gather round. Boodles climbed into her lap and Topsy sat by her side, while Popsi lay flat on the warm grass and looked up into her radiant face.

"Well, children!" said Spring. "I am glad you found me to-day, for I shall not be here very much longer."

"Oh!" cried the children in chorus. "You *haven't* got to go away, have you?"

"Why, of course!" said Spring, smiling a little. "You can't have me here all the year round!"

"Oh dear!" cried Boodles. "I *wish* we could. Spring is so much the loveliest time of the year."

"But you love Summer, when she comes, don't you?" said Spring.

"Why, Boodles!" said

Topsy. "Just think of hot days by the sea, when we can paddle and bathe again."

"I'd rather have Spring, with all the birds making nests," said Popsi.

"That reminds me," said Spring. "When you were looking for the dragon the other day, did you hear a willow-wren singing?"

"Come, then!" said Spring, and silently she led them through the thick undergrowth.

"*I* see the nest!" cried Popsi suddenly as they crept on hands and knees through the tangle. "Oh, such a darling little nest! Look! It has a little roof, and a door in the side!"

*Photo: Frances Pitt.*

A little round-nosed Water-vole was sitting on the bank enjoying the quiet June sunshine.

"Yes!" cried Topsy. "We did hear a sweet little warbly song."

"Before you came there was a little water-vole sitting here, and he told me that this morning Mrs. Willow-wren had hatched out four little birds!"

"Oh! Can't we go and look at them?" they cried, all together.

"Well, I shall have to make you invisible, I think, or the little mother might be afraid to come back!"

"We'll be just as quiet as little mice!" said Popsi.

On the ground, in a tangle of weeds was the little domed nest of the warbler. It was made of dry grass and roots, and lined with hair and feathers.

"Where are the babies?" asked Boodles.

"They must be asleep!"

"Now," said Spring, "I will make you all invisible, and you must lie very quiet, and then perhaps we shall see the little birds being fed."

Spring touched them, and the children became one with reeds

*Photo: Henry Irving*

SPRING AMONGST THE WATER-LILIES.

and bushes and splatter of sunlight. In the stillness a little song was heard. It began with a long high note, trickled down and down, and died away, softly, sweetly, into the air.

At once from the other side came another note—a sharp call, and out of the nest-door popped four little heads with big bobbly eyes and wide-open mouths. The lovely song of the father bird had only soothed them to sleep, but when mother called like that—then there was something worth waking up for. Out came the little heads, and in a flash the mother was there with a caterpillar in her beak.

Into the throat of the nearest it went, and away the mother-bird flew, while the four heads vanished into the darkness of the nest.

"Peep!" Again came the call; again the heads appeared. This time No. 2 swallowed the titbit, and all was quiet as before. For an hour the children lay and watched. Sometimes the mother would come with grubs or flies, and sometimes the father, until at last all were satisfied. Then the willow-wren sat again on the bramble-bough and went on with his own little plaintive song.

At last the children could keep still no longer. They jumped up and looked round for the fairy Spring.

Nowhere was she to be seen!

Out of the glitter of noon, ringing down a ray of sunshine, there came a clear silvery voice:

"Good-bye, children, good-bye! My work is done for this year; when the roses come out, then Summer comes in. . . . Good-bye . . . . Good-bye. . . ."

*Photo: John J. Ward.*

Whenever mother called, out popped the four little heads with mouths agape.

BUTTERCUP MEADOW.

*From an Autochrome by A. Havold Bastin.*

*Photo: Henry Irving.*

All along the hedgerow, at intervals by the side of the wood, Ragwort, in clumps of vivid gold, contrasts well with the many types of flowering plants which form the tangled undergrowth.

# SUMMERTIDE

## By TICKNER EDWARDES

UNDER the sweet June sunlight the cornfield lay like a calm inland sea—green wheat full grown, and in full green ear, breast-high, and all of a height—as I took the narrow path through its whispering, poppy-haunted deeps.

There is a scent of summertide lovelier even than the scent of June roses. When the month is at its prime, and the wheat stands thus at fullest growth with the fat ears bending over languidly in the gentle breeze, there comes a morning when the air takes to itself a strange new fragrance and a louder symphony than ever. The scarlet poppies, lurking deep down in the twilight of the corn, are always besieged by bees, making an undercurrent of soft sound for the chippering song of martin and swallow just overhead, and the unending carol of the larks far up in the blue. But now the sunken bee-music has come to the surface of the green lake of wheat. The fat ears are in flower at last, the wonderful June wheat-blossoming that scarce anyone sees. Each ear has thrown out an infinity of pale yellow tabs loaded with fluffy pollen, and the bees are rioting in these, rolling themselves in the impalpable dust, and sending it drifting away like smoke on the sun-steeped air.

But it is the scent of the wheat-flower that, midway through the wide green plane of cornland, brings one's step to an instant, wondering halt, and sets one luxuriously inhaling. There is a startling quality, as well as a charm, in its fragrance. For it is exactly like the sharp tangy odour of new-baked bread—the lightest, purest wheaten bread that ever came out of mortal oven: fairy bread, it might almost be, baked, as the story-books tell us, in the glow of moonbeams magically concentrated, and set to cool in a marble grot against Titania's feast.

*Photo : Henry Irving.*

Scarlet Poppies, lurking deep in the twilight of the corn, are always besieged by bees.

Lovelier even than the scent of June roses, I said. But winning a path at length through the wavering jungle of the wheat, and coming out by the old hedgerow under the beechen wood, I find it harder to discriminate. Against the impenetrable green of the wood, the old briar hedge lifts its towering battlements of pink blossom, giving back the morning sun with such a soft yet dazzling splendour, and drenching the air with such a perfume that the breath catches in its burdensome sweetness and overpowering strength. The wild rose is easily the first among flowers of high summertide, paramount alike in its form of simple beauty, its utter wildness, the purity of its scent. To have come to the briar hedge in a comparing mood seems now a pitiful thing. No other growth of summer deals out largess of loveliness to every sense with such royal munificence as the common dog-rose. To liken the beauty of any other growing thing to the squandered beauty of June roses is to compare with the incomparable. When the summer is gone and winter winds are harping again through bare tree-tops and surging over frozen fields, it will be the scent of wild roses that abides in the heart as symbol of high summertide above all other remembered, vanished things.

The June sun beats down hot from a cloudless sky. All along the old hedge that skirts the wood, the sheen of the roses makes a sort of pink mist in the greenery. I can see the white chalk path—trodden hard and smooth so that it has a mirror-like power of giving back the light—rippling away into the distance like a thread of burnished silver. It runs through a tangled wilderness of flowers heaped up on either hand, white chervil and bramble-bloom, vivid gold of ragwort, stars of purple mallow shimmering like satin, yellow vetch climbing high into the flanking thickets of roses, making a wreath of amber to every jewelled spray.

Clouds of midges dance in the torrid sunbeams. Gorgeous red-admiral butterflies flit on before me amidst a countless horde of lesser winged creatures, little blues and coppers, tortoiseshells, painted-ladies, bold veering fritillaries, hovering whites and clouded-yellows ; and all incessantly on the move in the brilliant light, so that looking down the woodside path is like gazing through a giant kaleidoscope whose colours are for ever changing, for ever grouping themselves into new visions of rainbow beauty—the living, flying colours adrift over a flower-diaper woven in every conceivable hue.

Here, under the lee of the beech wood, what little air was stirring out in the cornfield has not strength enough to move an aspen leaf. The heat and glow of the summer morning seem to gather intensity with every moment that passes. But a few paces onward the air melts into quivering violet haze so that every distant object has an outline as of a reflection in troubled waters. The far-off hills are but vague crumbling zones of shadowy blue, scarce to be distinguished from the azure of the sky beyond.

All the life and light of the summer seem to be filtering down into this serene, sheltered haven. Not a voice of full summertide is missing. It is hard to count the cuckoos, so many are sounding their clear double-chimes far and near. There is a nightingale literally in every bush. Little willow-wrens go by every moment clinking their silver castanets together as they fly. Thrush and blackbird and robin are singing—such a galaxy in concert that their songs blend inextricably into one melodious underflow.

Colour that is still, and colour that goes on wings; music that glides from branch to branch overhead, and music that hugs close to one secret nook of blossom hour by hour; limitless sunshine, and the fierce breath of summer noon scorching the cheek with its intolerable benevolence: it is all too much for the average timid workaday human soul. One drinks and drinks deep desperately, again and again at the brimming, exhaustless chalice of the season. But there is a sort of growing fear in every draught. There comes suddenly a moment when one can, and will, drink no more. That moment came for me. I turned, and sped deep into the cool dark corridors of the wood, nor paused until a safe half-mile of its shielding quietude and stillness lay behind.

Quietude of crooning pigeons and the wood-top murmur of the gentle breeze. And now another sound comes drifting down into the green forest twilight, a sound of many

*Photo: Henry Irving.*

The Trailing Dog Rose displaying its cascade of blossoms down the hedge. No other growth of summer deals out such largess of loveliness.

**WILD ROSE BUS**

To many a wayfarer by woodland paths, the Wild Ro

*Photo: Henry Irving*

**N FULL BLOOM.**

stands as the supreme symbol of high summertide.

voices far up above the dense fan-tracery of beech-leaves, as an invisible host of rooks and daws sails by in the tranquil blue squabbling opulently as they go. But in a little while the rich, hoarse, drowsy symphony has died away in the distance.

*Photo: A. L. Chislett.*

The Lesser Stitchwort, plentiful in the gloom of the summer woods, despite a formal prettiness, brings content in contemplation of its neat white double stitches sewn star fashion, over a pale green gown.

Again the ring-doves and the murmuring breeze have the whole wood to themselves. I look about me, stretching arms of indolent relief, and marvelling how these two quiet notes—the steady undertone and the slow, sweet, effortless chime—serve only to accentuate the woodland quietude and make its instant solitariness the more complete.

This spirit which sometimes, at the first full earnest of summer, impels one to leave the sun-flooded, flower-garlanded fields and lanes, and wander deep into the heart of a wood, is not the mere natural human penchant for coolness and shelter. In this English land of ours one seldom has too much of the sun's heat. It is never a land made weary by sunshine, wherein one pines for the blessing of the great rock's shadow. The impulse is born rather of a conviction of too overwhelming good—a vision of oneself as a vessel of well-being too dangerously full. If you have tried to keep step and step with the upheaval, the sheer tumultuous overbrimming, of the earth's life during the past weeks, you will feel something within yourself as of the strain of new wine in old bottles. Though this life is what it is, and every man must take his turn at the oar over its grey tossing sea, we cannot all dull the heart's edge in cities. To some of us is given the task of watching the summer in from the old sane vantage-points. And then, if you are of these favoured yet burdened few, there dawns a day at length when the prodigal magnificence of it all is no longer to be borne. An end has come to human endurance, even of beauty. You turn your back on the sunshine, and go to rest your little surfeited soul, as I have done, in the dimness and quiet of the nearest wood.

Measured and slow the voice of the ring-dove dwells in the silence about me. The west wind talks far above. Though scarce a blink of the blue sky shows through the matted wood-top, there are skeins of sunlight like golden cobwebs festooning the path ahead. The path itself is of a rich dark brown, a solid paving made up of the

*Photo: G. C. S. Ingram.*

**WHITE FIELD OR TRAILING ROSE.**

To liken the beauty of any other growing thing to the squandered beauty of June roses is to compare with the incomparable. The White Field Rose with its golden anthers is scarcely less lovely than the pink Dog Rose.

*Photo: John C. Mill.*

Here, under the lee of the Beech wood, the unstirred heat-waves of a summer morning seemed to gather intensity as the sun rose to high noon.

trodden leaf-fall of a decade lightened at its verges by the cast beech-flowers gathered like amber snow-drift by the way.

Over this soft carpeting one goes as silently as a stalking fox at night. A green woodpecker, scrabbling in the dead leaves a hundred paces onward, lets me come almost upon him before he rises on the wing with his hollow cry, half fear and half sardonic mockery, and wheels away through the tree-trunks, flying in long sagging loops like a finch. At every turn of the path I light upon something beautiful or curious. Now it is a bevy of young rabbits hobbling about an old ivied tree-stole, and now a couple of hares chevying each other and tumbling over together like puppies at play. Stopping presently at sound of a soft rustling in the wayside grass and an intermittent anxious clucking, I realize that a hen-pheasant is near by with her young brood. I shall see nothing of the little family, look as carefully as I will. But I note the stealthy parting of the grass-blades as the chicks follow the receding call of the mother, until the track of bending swathes and the care-ridden, chiding voice fade away together into the far deep of the wood.

Turning a little later into one of the quietest and dimmest of the forest glades, a sudden shrill scolding note breaks out almost under my feet. There is a lightning flourish of tawny fur across the path, and straight up the nearest tree-trunk, where it comes to rest on one of the overstretching branches—a spot of glowing quivering colour caught in an errant sunbeam: a frightened, very angry squirrel still scolding volubly, and looking down upon me with eyes of polished jet. There is no creature of the wilds which resents human intrusion on his solitude more vigorously and vociferously than the true wild squirrel. Though I wait an hour inert and mute below him, he will still bide there aloft, watching me with his beady bright eyes, his great bushy cinnamon tail for ever lashing wrathfully. Nor will he venture down again until all sight and sound of me has vanished in the far blue gloom of the forest glade.

But it is the small winged things that love woodland quiet and obscurity, and the still-life of flower and herbage, which most attract me in my present sun-fugitive mood.

Pleasant it is to look upon a single butterfly now, after the thousands that filled the

glowing world I traversed a while ago. Slowly she flits along the shadowed way, a pale white fleck trifling with the heads of rosy campion and purple bugloss in her course : ever onward without a pause, yet seemingly without a purpose : a dim hovering form, the mere wraith of a butterfly —a green-veined white, that would have an arresting brilliance in the open, but stands now for little else than sober afterthought.

Stitchwort in the gloom of summer woods —and here it is in plenty—brings one the same healing content of heart, to look upon its formal prettiness, neat white double-stitches sewn star-fashion all over a pale green gown. And the astonishing wood-spurge that, in fair weather or foul, ever seems to give out an intrinsic radiance of its own, stem and foliage and crescented flower all the same in colour and all suffused with the same furtive yellow light.

But here is something which fits in more completely than any with my inglorious, sun-evading mood, and may well serve effectually to quench it. To realize the utter detachment, the sheer octogenarian indifference, of the broomrape to all the riotous, wantoning, madcap youth of the world outside, one must go on hands and knees to it in its dim corner, here where the green woodland half-light and murmuring stillness are most profound.

It grows on a little plot of rabbit-nibbled sward—safe itself from harm, for no creature will touch it—a single leafless spire of pale tobacco-brown, thronged with tier above tier of flowers of the same sad hue, each flower shaped like a thick, stubby human hand half open, and in the clutch of the hand a knot of dull amber beads. It is hard to look for long upon the broomrape without getting a sudden eerie feeling, a sort of whiff of the underworld, from its uncanny parts, and an equally sudden desire to be out among honest, open-air buttercups again. One goes back to the glittering meadows, the rose-garlanded lanes, the glowing cornlands, cleansed and ready for another draught at the spring of real light and life.

*Photo : A. W. Dennis.*

Banked up against the briar hedge, the Dog Rose finds the sunlight in many a shady corner by the wayside.

*Photo: Frances Pitt.*

One of the most noticeable peculiarities of the Brown Hare is the marked difference between the fore and hind limbs, the latter being nearly twice the length of the former.

# 9.—THE WAYS OF THE HARE

By W. S. BERRIDGE, F.Z.S.

HARE, a small four-footed animal, with long ears and a short tail, that moves by leaps and is remarkable for its timidity, vigilance and fruitfulness. The first year it is called a leveret, the second a hare, and the third a great hare. Her ears lead the way in the chase, for with one of them she listens to the cry of the dogs, while the other is stretched, like a sail, to promote her flight." This quaint description, taken from an old dictionary, may be regarded as being like the proverbial curate's egg which, as the reader is well aware, was good in parts; for although no fault can be found with the opening passages, yet the concluding portion is without doubt somewhat highly flavoured.

Let us proceed to examine this small four-footed beast a little more definitely. Measuring about twenty inches in length from the tip of its nose to the root of its tail, the latter being only an inch or so in length, the hare exhibits several peculiarities that are of special interest.

Of these, one of the most noticeable is the very marked difference between the fore and hind limbs, the latter being nearly twice the length of the former. It is owing to this fact that when the animal is moving

in a leisurely manner it progresses in a series of lolloping and somewhat ungainly looking jumps; but, on the other hand, when it is fleeing from an enemy, such as a dog, it shows a degree of agility that is truly remarkable—turning aside from its course by jerky leaps that are called "doubles" or "wrenches" by the sporting fraternity.

The speed with which it is able to run when hard pressed can well be judged by quoting a letter that appeared in the correspondence column of a daily newspaper a short time back. The writer stated: "The relative speed of hares and greyhounds was, a little while ago, the subject of a discussion in the Australian and New Zealand press. One correspondent told how, when he was riding a motor-bicycle in New Zealand, a hare started up before him on a dead straight country road. For half a mile he managed to keep 'on the hare's tail,' and the trustworthy speedometer on his machine showed a record of forty-five miles an hour. This, he pointed out, worked out at half a mile in forty seconds, which was five seconds better than the best time made by Gloaming, the crack New Zealand racehorse."

Much depends upon the nature of the ground over which the hare is travelling as to how quickly it is able to proceed, for its long hind-legs are better adapted for running up- than down-hill. When descending a steep slope it is apt to topple over should it travel too fast, and, according to report, to obviate this danger it will sometimes progress in a zigzag fashion, like a ship tacking.

Photo: Charles Reid.

The ears of the Brown Hare are longer than its head; the prominent eyes enable the creature to see behind itself when pursued, but, by their position, are defective for looking straight in front.

Another difference to be noted between the front- and hind-legs is that the feet of the former are provided with five toes, and those of the latter with but four, the soles of all being covered with short hair. The hare's teeth are unlike those of the majority of rodents, inasmuch as there are two pairs of incisors in the upper jaw, the second pair quite small and concealed behind the larger ones. The ears are remarkable for their large size (their length exceeding that of the animal's head), while the inner sur-

Photo: G. A. Booth, F.Z.S.

The Hare makes no burrow, but sleeps and brings forth her young in a grassy lair or "form."

face of the cheeks is lined with short hairs, and the eyes are so large and prominent that the creature is able to see behind itself when fleeing from a foe. Its vision, however, is defective for looking straight in front.

The colour of its coat is usually of a tawny-grey tint with the underparts white, but during the winter months it is generally somewhat greyer than at other times. All-black, and even entirely white, hares have been recorded. The tail is black above and white beneath, and the ears are tipped with the former colour.

Found over the greater part of Europe, but not in Ireland, Scandinavia, and northern Russia, the hare is of a shy and timid disposition. Owing to its defenceless condition its life is one continual struggle for existence, and were it not for the protection afforded it by the Game Laws, there is little doubt that its numbers in Great Britain would be far fewer than they are at present.

Not only has it to contend against the attack of the fox, weasel, stoat, crow, and eagle, but it is also largely hunted by man with the aid of greyhounds, basset-hounds, harriers, and beagles. In the endeavour to escape from the hounds, the hare displays much endurance, and also shows a considerable degree of artfulness. Unless it be confident of escaping from its pursuers at the outset of the chase by bolting straight away, it reserves its strength and tries to tire them out ; and when fleeing from a greyhound it keeps ahead just sufficiently to avoid being caught by the gaping jaws of its enemy—occasionally dodging to one side, or turning so rapidly that the dog loses ground before it is able to change its direction and follow in the footsteps of its would-be victim.

The hare will also take advantage of any opportunity afforded it of jumping through a gate, an opening in some wire netting, or a hole in a fence ; and in this manner it often succeeds in escaping from its pursuer.

When chased by harriers, beagles, or basset-hounds, all of which hunt by scent, the animal will sometimes mingle with a flock of sheep so as to throw the dogs off the trail ; while it has also been known to

run along the top of a newly-cut hedge, or to swim a stream in an endeavour to escape.

It can leap vertically to a height of five feet, and in a single forward bound has been known to cover a distance of five yards. When running at full speed the impress of the hind-feet appears in front of that of the fore-feet, making a group of marks something in the form of a reversed 7.

Except during the mating season, when the males fight furiously with one another, the hare leads a solitary life. Although it is generally accounted a timid animal, it is, as a matter of fact, an exceedingly courageous one. In defence of its young it will not hesitate to attack even human beings.

Unlike the rabbit which seeks safety within burrows, it spends all its time above ground, making its home beneath the shelter of a bush or amidst some herbage, and scratching away a shallow depression in the soil which is known as its "form," this residence being changed from time to time.

In the early spring the animal's temperament undergoes a peculiar transformation. It no longer acts with the discretion that formerly regulated its conduct, but dashes about in a manner that has given rise to the saying "as mad as a March hare." Its fits of wildness are noticeable chiefly during bad weather, and in the afternoon rather than at any other time of the day.

Several litters of young are born during the course of a year, the breeding season extending from early spring to September. In exceptionally mild winters quite young hares have been seen as early as January.

The leverets, as the young are called, number from two to five in a litter. They have their eyes open at birth and their bodies clothed in fur—thus differing from the rabbit, the young of which are born blind and naked. The mother is very attentive to her offspring, and realizing their defenceless condition she deems it best to hide them separately, making each one a little form of its own, and concealing them to the best of her ability. By this means the risk of all her family being killed by a lurking foe is reduced to a minimum. She visits them at regular intervals in order to

*Photo: G. A. Booth, F.Z.S*

The particular speckled brown of the Hare's fur makes it almost imperceptible when lying in its "form" amidst tangled brown grass.

*Photo: Riley Fortune, F.Z.S.*

Unlike young rabbits who are born blind and naked, Leverets have their eyes open at birth and their bodies clothed in fur.

feed them, and when coming or going endeavours to hide her scent by crossing swampy ground, or even by entering the water. She takes pains, too, with their education, teaching them how to behave in times of danger, the art of "freezing" or "clapping" (crouching low down and remaining motionless upon the ground so as to avoid being seen) being one of the first lessons that they have to learn. The male hare has little to do with his offspring, but leaves the task of rearing and educating them entirely to the mother. Fortunately for her, however, they soon become independent; when a month old they are left to shift for themselves and about a year after their birth they undertake parental duties on their own account. Leverets become very tame in captivity; the writer knew of one individual that was brought up with a pair of nestling blackbirds and fed with milk and water, which it sucked out of a doll's feeding bottle.

The hare, known in some parts of the country as "Puss," the "grass-cat," and also as "Sarah," is mainly nocturnal or crepuscular in habits.

It is found in cultivated districts, and often does much damage to growing wheat and garden vegetables; while it is also responsible for killing numbers of young trees by gnawing away and feeding upon the bark. Although usually silent, it will at times give vent to an inward grunt, and when caught it utters a most pathetic scream.

Except for the mountain hare, which is found only in the wilder parts of Scotland and Ireland, and which will be described in a separate article—this brown hare is the only one known in the British Isles. Owing to its habit of extreme caution and timidity it may not often be seen by the casual wayfarer, yet there must be copses or open fields and downs where those who walk silently and keep their eyes and ears alert, may not get a momentary glimpse of this—the fleetest and most wary of our wild animals.

*Photo: Frances Pitt.*

A half-grown Leveret. At about a month old Leverets are left to shift for themselves, and at about a year old they undertake parental duties on their own account.

*Photo Riley Fortune, F.Z.S.*

**THREE LEVERETS IN THEIR "FORM."**

A litter numbers from two to five individuals. Usually the mother makes each one a form of its own, and there hides her offspring to reduce the risk of death by a lurking enemy.

# 14.—THE MOST BEAUTIFUL MOTH FAMILY: THE HAWKS

By H. M. CRAWFORD

With photographs by the Author

FROM the earliest days of summer to the beginning of winter some of the hawk moths will be on the wing. The first to show itself is usually the humming-bird (*Macroglossa stellatarum*). As

The little Humming-bird Hawk Moth (*Macroglossa stellatarum*) is usually the earliest to show itself. Its proboscis, when uncurled, is as long as its body. (*Enlarged.*)

a rule, it appears in May, but it has been seen as early as March. This moth is a good example of the typical differences between the *Sphingidæ* (or hawk-moth family) and most of the other large moths. Also, incidentally, these differences upset many of the amateur's ideas about distinguishing marks regarding moths and butterflies as a whole. Moths, for instance, usually fly at dusk and butterflies in the sunshine, but here is the humming-bird that prefers sunlight to twilight, and sucks nectar from flowers. Then the antennæ of moths may be bristle-like, thread-like, spindle-shaped, dentated, and so on, whilst those of butterflies terminate in a club or knob; but the scaly, bristly hooks at the tips of the humming-bird's antennæ strongly suggest the butterfly's club or knob. Again, butterflies are considered more gorgeously coloured insects than moths, but in all the range of insect liveries there are none so exquisite and gorgeous as those of the hawk moths.

As an instance of this beauty of colouring, the lime hawk is, without exaggeration, one of the loveliest things on earth. To see it in perfection the pupa or chrysalis should be procured, and the moth's emergence between May and June, in its first purity of colour, watched for. It is a marvel of pale olive-green loveliness. The fore-wings are crossed with irregular dark green markings, varying in shape, size and tint, and at the waved edges there is an olive-green border. The soft down on the head and round the eyes is of the palest green, with just a hint of warmth. On the pale greeny-brown margin of the hind-wings, which are concave near the anal angle, is a broad band of darker colour, often of a delicate plum-bloom shade.

The caterpillar of the lime hawk is also green, obliquely striped with yellowish-golden bands that are outlined with pale purple. Most caterpillars are either hairy or smooth, but the skin of many of the hawks can only be described as granulated, like

What a Lime Hawk Moth (*Smerinthus tiliæ*) looks like a few hours after emergence from the chrysalis. It is one of the commonest Hawk Moths in the British Isles.

shagreen. Looked at closely it will be seen that the lime hawk larva has green for the underlying and ground colour, and this is sprinkled with little gold dots. There is also a horn at the end of the body, as in most of the hawk larvæ, and this also is beautifully coloured—purplish blue above and yellow underneath.

All the hawk caterpillars are worth rearing for their beauty alone; in many cases their delicate colouring defies description. In addition, they have many remarkable characteristics. They take their family name of *Sphingidæ* from the strange, sphinx-like attitude assumed by some when disturbed or alarmed. The common poplar hawk caterpillar and the equally common privet hawk, if touched, immediately take up this position. The elephant sphinges, as larvæ, have a different habit; instead of raising the head when alarmed they contract the first three segments of the body and take on a snake-like appearance. On the fourth and fifth segments are round, dark spots with white centres; when the first three segments of the body are contracted, these spots resemble eyes. Possibly this attitude is adopted in order to terrify its enemies. In its normal position the caterpillar's head seems extremely small, the first two segments tapering towards it, and giving the caterpillar a shape something resembling an elephant's trunk; hence its popular name.

The following is a full list of the hawk moths that are seen in the British Isles: humming-bird (*Macroglossa stellatarum*), broad-bordered bee (*Sesia fuciformis*), narrow-bordered bee (*S. tityus*), oleander (*Chœrocampa nerii*), silver-striped (*C. celerio*), elephant (*C. elpenor*), small elephant (*C. porcellus*), striped (*Deilephila livornica*), madder (*D. galii*), spurge (*D. euphorbia*), pine (*Sphinx pinastri*), privet (*S. ligustri*), convolvulus (*S. convolvuli*), death's-head (*Acherontia atropos*), eyed (*Smerinthus ocellatus*), poplar (*S. populi*), lime (*S. tiliæ*). There are seventeen in all, though a few are very rare and doubtful natives. The commonest are the humming-bird, the poplar, the privet, the eyed, the lime, and the two elephants. The largest, and the only one, with the possible exception of the eyed, that is harmful, is the death's-head. The bee hawks, both day-fliers, are only common in certain places. The oleander is very scarce, and is usually regarded as a casual immigrant, finding its way here during very hot summers in its migration northwards. In the south of Europe it feeds on the oleander, chiefly on the blossoms, but caterpillars reared in Great Britain have fed on *Vinca minor*, the common small periwinkle.

A newly-emerged Poplar Hawk Moth (*Smerinthus populi*) drying its wings.

Another rare species is the convolvulus (sometimes called the unicorn); this moth also is quite able to fly over from the Continent, and all specimens found here are supposed to be immigrants. The beautiful silver-striped is another immigrant; though it possesses a wing expanse of only three inches it is exceedingly strong and active; frequently it is found at rest on ships at sea, thus proving that it is in the habit of crossing from one country to another. The striped hawk, popularly so-called on account of the white stripe down the middle of the olive-brown abdomen, has large, prominent eyes and a very striking appearance; the fore-wings are olive-brown, with pale yellow band and greyish margins, while the hind-wings are reddish-pink with a very dark coloured band near the margins; a further characteristic is that it produces a distinct humming sound when flying. To the same genus (the *Deilephila* = evening-loving) belong the very rare spurge and madder hawks, the latter, though extremely sensitive to cold in its larval state, can breed in Great Britain.

A Poplar Hawk Moth Caterpillar, if touched, immediately assumes the characteristic "Sphinx" position, which accounts for the family name of *Sphingidæ*.

The lovely pine hawk, with its narrow, pointed, pinkish-brown and ashy-grey wings, is certainly a British native, but it lives almost exclusively in Suffolk. An old writer has called it the "fir-tree arrow-tail moth," because its caterpillars feed on firs, also because of the broad, arrow-like mark on the dark brown abdomen.

It is in May generally that one sees the first humming-bird and bee hawks. These are not common in all districts, or rather they are uncertain in their appearance, and their flight is so different from that of ordinary moths that they are very often missed. In the case of the humming-bird there are several broods up to September; the moth has a very quick, bird-like way of flying, and possesses a proboscis as long as the body. It hovers and darts amongst the flowers, probing the blossoms while still on the wing. It is specially fond of the blue viper's bugloss, though the caterpillars feed on bed-straw and the glossy, whorled leaves of the wild madder. The female moth will sometimes deposit her eggs without alighting, turning up the tip of the abdomen so as to reach the underside of the leaf. The narrow-bordered bee hawk has the same habit; she lays her eggs on the undersides of honeysuckle leaves, where they may easily be detected.

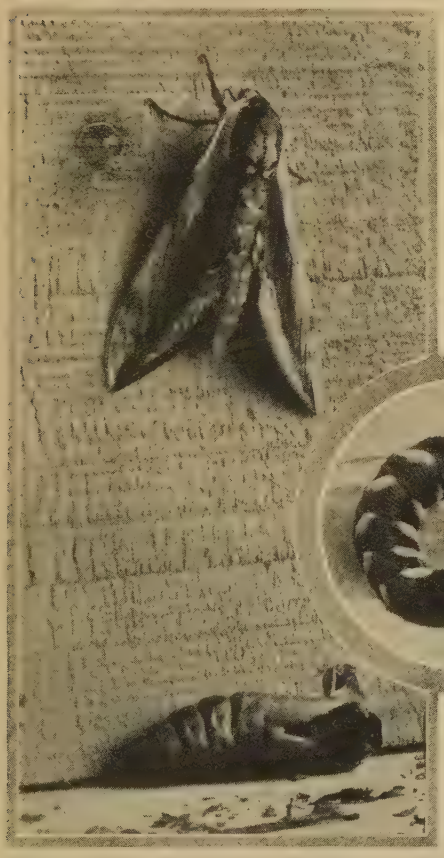
The Poplar Hawk Moth is quite common. Although the ground-tint of the wings, when fully developed, is usually a reddish-brown, the colour and markings vary considerably.

The little bee hawks, with their short, stout bodies covered with long hair, their long antennæ, their transparent, bordered wings, are marvellous little creatures; but they are so much like bees, and their flight is so incredibly swift, that they are rarely noticed. The wing expanse of the largest never exceeds two inches. The body of the

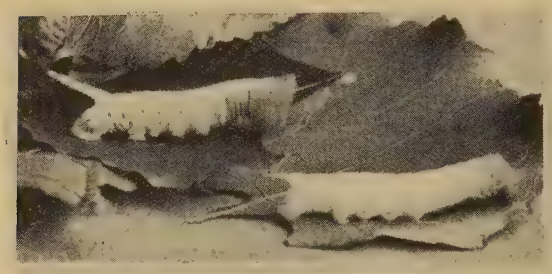
broad-bordered bee is yellow-green, with two reddish-brown bands on the abdomen, and a black and yellow anal tuft ; the body of the narrow-bordered is a beautiful golden-green, with bands of black and orange and a black and orange anal tuft. These features, together with their hovering, curving, darting flight, cause these sun-loving insects to resemble bees more strongly than moths. The only time when it is easy to see them is when they hover and pause over a flower. The fact that the wings of both the bee hawks are dusted with fine greyish-black scales on emergence from the pupa case seems to indicate that there was a time when the wings were always scaled, and that the scales have gradually disappeared.

The largest British moth is the death's-head hawk. It is not very common, fortunately for the interests of the farmer and the market-gardener. It has a fondness for honey, and is known in the south of Ireland as the " bee-robber." It is extremely abundant in eastern Europe, where it does a great amount of harm, and is there generally regarded with superstitious dread as a fore-runner of disease and death. This is not altogether on account of the harm it does, but because of the fact that it is able to produce a sound resembling a squeak, and is also capable of emitting a strong musk-like odour when pressed with the fingers. The squeak may be made by friction of the palpi against the base of the proboscis, and it has been compared to that made by a pencil

When the larva of the Elephant Hawk Moth (*Chærocampa elpenor*) is alarmed it contracts the first three segments of the body and takes on a snake-like appearance. The dark spots with white centres on the fourth and fifth segments now resemble eyes. (*Enlarged.*)



A newly-emerged Privet Hawk Moth (*Sphinx ligustri*) with its empty pupa case. Inset, a fully-grown caterpillar of this moth as it appears at the end of summer, just before pupation.



The larvæ of the Eyed Hawk Moth (*Smerinthus ocellatus*) live on willow and poplar leaves, but they will also thrive on apple and pear.

on a slate. Another theory of the squeak is connected with a little cavity or bladder situated in front of the stomach; it is thought that the moth is able to fill this cavity with air, and to eject the air sharply through throat and proboscis. This noise is made when the moth is handled or disturbed in any way. It is regarded with superstition by country people also because of the curious pale mark borne on the thorax, which so strongly suggests a human skull that the fact is recorded both in the scientific and the popular names.

Although both moth and larva are large, neither is seen very often, but the pupæ are frequently dug up in potato fields. The caterpillar—which when full fed is often six inches in length—prefers the flowers and leaves of the potato plant to any other vegetable food, but it has been found feeding also on jasmine, woody nightshade, tomato and tobacco plants.

The privet, the eyed and the poplar hawks are very common and very beautiful. They haunt the open parts of woods and their outskirts, and flat open country as well as gardens. They all fly at dusk, and are easily attracted by a light. One of the photographs shows a privet hawk and its empty pupa case. This moth was bred in captivity from a caterpillar that had fed on lilac leaves the preceding summer; its long, grey, pink-tinged fore-wings, as it clung to the rough wood like a huge fly, were now and then raised sufficiently to give a glimpse of the rosy-red hind-wings and body; the antennæ were thick and white and long, slightly hooked at the ends. A strange thing about this species is that sometimes it remains in the pupa state for two years.

The photograph of the poplar hawk shows the peculiar way in which it holds its wings; these vary considerably in colour and markings, but usually the ground tint is reddish brown. Its antennæ are dark red along one side and dull white on the other. The caterpillars are beautiful in their coats of golden-green dotted with lighter gold, and with their seven oblique pale yellow lines on the sides of the body. They are subject to curious diseases, and if the food supplied in captivity has not just the right degree of dampness they die. The same happens to the larvæ of the elephant hawks. On the other hand, the larvæ of the eyed hawks live and thrive even in really adverse circumstances. They will live very well on leaves of apple or pear, as well as on their more usual diet of the leaves of willow and poplar.

The eggs of the hawk moths are a decided green colour, large, and generally smooth. Closely-packed groups are uncommon; they are oftener laid singly or in twos and threes. A peculiarity of the hawks is that the caterpillars will eat only the leaves of the plant or tree on which the eggs were laid.

The Eyed Hawk Moth has a peculiar method of walking. Its attitude displays its very beautiful wing markings to advantage.

# 15.—THE GIANT TAILED "WASP"

By T. M. BLACKMAN

With photographs by the Author

WALKING through a pine wood with observant eye, one may occasionally see upon the trunk of one of the trees what might pass as a large hornet. So wasp-like in fact is the insect with its inch-long black and yellow body that it is not surprising that those unfamiliar with it should consider it an undesirable insect with which to make a close acquaintance. If, however, we note that the yellowish thread-like antennæ are about one-half the length of the body and that the latter is, from the head downwards, cylindrical in form and of fairly uniform thickness until it abruptly passes off into a slender tail, we may conclude with tolerable certainty that the insect is in reality a female of the giant tailed "wasp" (*Sirex gigas*). It is really not a wasp at all, and although it is sometimes credited with doing considerable damage to pine trees while in the larval state, there need be no fear of anyone receiving personal injury from the insect.

The male giant tailed "wasp" is rather smaller and less conspicuously coloured than his mate, and is less often seen on the trunks of trees. The female is there because she pierces the thick bark of the trees with her long ovipositor in order to lay her eggs next the wood of the trees on which her grub will feed. The tailed wasps may be regarded as first cousins of the saw-flies; but the ovipositor, instead of being like a saw, is developed into a very efficient and wonderfully adapted drill. This instrument is in reality one of the most remarkable adaptations to be found in the whole insect world.

Although the female will sometimes cause conside able damage by laying her eggs in newly felled timber, her more usual habit is to attack unhealthy and dying trees. While in the act of drilling the bark and laying her eggs she is unable quickly to withdraw her long ovipositor, and when we find one so engaged it becomes an easy matter to effect her capture. If roughly handled, however, part of her body may be broken off, and the ovipositor left embedded in the bark.

At one time I captured a "wasp" while so engaged upon a pine gate-post from which the bark had not been removed, and she gave me several exhibitions of her boring powers. I had her under observation for several hours, watching the process of boring and the no less remarkable method of setting up and packing away the drill.

Female Giant Tailed "Wasp" (*Sirex gigas*), which is really not a wasp at all. Its thread-like antennæ are about one-half the length of its body, which is cylindrical and of a fairly uniform thickness, until it passes off abruptly into a long, slender tail.
(2½ *times natural size.*)

The flexible drill, or ovipositor, is nearly as long as the insect's body, and in order to use it effectively it is necessarily affixed to the lower part of the body in a fairly central position. It requires, therefore, special arrangements not only for carrying and protecting it, but also for bringing so long an instrument into position for use. It is attached to the lower surface of the forward part of the abdomen by a strong flexible hinge, and when not in use rests between the two halves of a fixed and stiff sheath which lie parallel with the insect's body.

When about to use the drill the insect has first to raise its body as high as possible on its legs, while the antennæ are pressed downwards upon the bark and appear to aid the legs in steadying the body throughout the operation. The insect then bends its abdomen downwards, bringing the end of the sheath containing the drill forward between the back legs until the tip touches the bark in advance of the back feet, when the body is straightened, causing the sheath to return with it to the normal position and leaving the drill in position for boring.

For this operation sufficient pressure is then put upon the flexible drill to cause it to bend slightly, and by means of the powerful muscles at its base a motion is imparted to it similar to that obtained by pressing heavily upon a thin stick with one hand and imparting a slight circular movement to the bowed-out middle part of the stick with the other hand. A revolving motion being unattainable, a very good substitute for it is thus arrived at, and in this way the ovipositor makes its way slowly but steadily deep into the thick bark of the tree. The motion imparted to the instrument causes the outer part of the hole to be enlarged and the loosened material worked up as the depth increases. Thus friction is reduced to a minimum, and at the same time the ovipositor is not endangered by becoming immovably fixed in the bark.

The individual before mentioned was so obliging as to give me several exhibitions of her boring methods while confined in a large cardboard pill-box, and after a good deal of disappointment I succeeded in obtaining a satisfactory photographic record of her in the act of boring through the side of the box.

An enlarged view of the female Giant Tailed "Wasp" (*Sirex gigas*) seen in the act of boring through a cardboard box. The flexible drill, or ovipositor, is placed between the hind-legs during the operation, and when not in use it rests between the two halves of a fixed sheath which lie parallel with the body.
(*About 2½ times natural size.*)

*Photo: Edward Step, F.L.S.*

An extensive sand-pit, which appeared at a cursory glance to be quite ordinary, but which, on closer examination, revealed itself as a stronghold of a very engaging beetle—the Trident-bearer.

# 16.—THE TRIDENT-BEARER

By EDWARD STEP, F.L.S.

THE boisterous nor'-easters have slackened and given the sun a chance of doing a little earth-warming. Here, on the dry, heather-clad Bagshot sands, the warmth is more speedily absorbed, and as I plunge my hand into the low scrub in a vain effort to capture the first lizard of the season, I become aware that the network of wiry stems entangles much of this welcome heat. In the hollows, where there is a little moisture that the desiccating winds could not reach, the sallows are coming into their vernal glory of silver and gold. The earlier of the two forms of birch—that with the base of the trunk thickly clothed with rough, black bark—has softened its long male catkins, which are shaking out their golden pollen. A female adder, just emerged from her winter retreat in a mouse's run, has coiled herself neatly on a sunny bank in order to absorb the warmth before she starts hunting.

Before us is an extensive sand-pit in whose less disturbed slopes we may find a few of the earlier mining bees already at work on their tunnelling But first, there is something to take note of on the undisturbed margin of the pit. It does not, perhaps, appear worthy of a moment's consideration; rather as a feature to be passed by unnoticed. A low, rounded heap, originally thrown up by a burrowing mole, and then taken possession of by the wild thyme, has been almost covered by rabbit-droppings, showing that the mound is a favourite sanitary resort of the familiar rodent. Nothing remarkable; in fact, quite a common object of the heathlands; but often the chosen elevation is a broad tree-stump. What attracted attention was the fact that one of these dry droppings appeared to be slowly moving *up the slope*, not rolling down as anything of similar shape might be expected to do. We grab the moving one, and find that though in size, shape and colour it is very like a rabbit-dropping, it is, in fact, a very convex beetle whose food is rabbit manure. Long known as a common insect under its familiar name of pill-beetle, nobody appears to have been

struck by the fact that it is a good example of protective resemblance. No insect-eating bird is likely to pick it out as an edible morsel from among such similar surroundings.

Twenty yards or so beyond the thymy mound there are a number of perforations of the ground looking as though someone had aimlessly stabbed the surface with a walking-stick. Half-way between these points a beetle of another sort is moving somewhat laboriously away from the perforations — a solidly built, shiny black fellow with a vaulted roof to his back along which runs a number of deep parallel grooves. Nearly three-quarters of an inch in length, his breadth is only a third less, and his powerful bristly legs have stout tooth-like projections along the outer edge. But the features that give him distinction, reminding one of larger relations found only in warmer countries, are three solid spines pointing forwards from his fore-body, as though this trident were intended for butting at an opponent. Of this set of weapons or ornaments, the central spine is straight and much shorter than the lateral ones, which are curved slightly towards each other.

*Photo: E. Step. F.L.S.*
The familiar Pill-beetle (*Byrrhus pilula*), whose food is rabbit manure, which it resembles in shape and colour.

This handsome little fellow is the male of his kind ; the female might be taken for another species, for she has no very obvious suggestion of the formidable-looking trident. Her fore-body has merely the beginnings of the lateral spines, so small that they have to be looked for closely before they can be seen ; often there is only a depressed, wrinkled and punctured patch where the incipient spines should be. In other respects the sexes are alike, and the reason for the undeveloped spines in the female may be found possibly in her different rôle in life.

In both sexes the antennæ end in a knob which, on a close scrutiny, is seen to be made up of three thick plates. This multiple-clubbed antenna is the family badge of all the scarabs, to which family our trident-bearer belongs, and it appears to be a sort of aerial for the reception of wireless messages and other atmospheric impressions. The jaws, which are fairly evident, are flat with toothed edges.

Like many other things, this trident-bearer (*Geotrupes typhœus*) has been awakened to activity by the genial rise of temperature. Last autumn he lay as a chrysalis far underground, with his undeveloped wings and legs swaddled around him like the limbs of a mummy. One day all these imprisoned appendages expanded and burst their bonds, and a soft *white* beetle found himself standing in a dark cell, perhaps as much as five or six feet underground. After a time his integuments darkened, and hardened into a horny consistency, and his limbs became firm and usable.

His future mission lay upon the surface of the earth and in the free air above it ; and as soon as the hardening of his external skeleton was completed he set about reaching his field of action. To this end Nature had fitted him out with the sense of direction. In the dark he knew which way to turn. Climbing up the wall of his prison, he began to scrape upwards with the broad shanks of his front legs. As the earth was loosened by these tools it fell around him and was pushed behind by his last pair of legs, whilst the middle pair secured his position in climbing. At last, the final inch of earth was cut through, and the trident-bearer scrambled out upon the flat with the unwonted blaze of evening sunshine penetrating the many facets of his compound eyes. Unaided he had tunnelled vertically through a thickness of earth equal to about seventy-five times his own length, which is as though a man had scraped with his hands through more than four hundred feet !

This enormous task had nearly used up his reserves ; he had eaten nothing since he cast his last larva skin late in the summer, and he now experienced a desire for food. Shaking out the leaves of his antennæ, he waved these organs about, and became aware of a very pleasing impression. Dinner had been served, and was waiting his pleasure. He was not yet sure where the table was spread, but raising his horny wing-covers —now quite black—he extended his brown parchmenty wings for the first time, and with a few beats of them rose into the air in a spiral. Finding that the appetizing odour came from the south-east, he headed straight

in that direction and landed in a pasture at no great distance where numerous sheep were mowing the grass. Here a heap of black, oval pellets attracted him, and he ate to repletion.

He fed as sumptuously on several succeeding evenings, and then, as the nights grew chilly, he appeared to have visions of winter—a time when the earth would be frozen hard, and hungry birds and beasts might not disdain to eat even a black scavenger beetle. So he set to work digging a shaft in the sandy soil near where he had emerged from the underworld. He would have preferred, perhaps, to dig near his restaurant, but the pasture was on tough, heavy clay. Near the sand-pit the soil was light and excavated with ease, and a well-drained retreat was assured. So he hied back there and sunk a shaft nearly a foot in depth, and about half an inch in diameter. Then he made a number of visits to the neighbouring rabbit midden, each time selecting a dry pellet and rolling it to the pit-head by pushing with his head and guiding with his fore-legs. When he had dropped a sufficient number of these pellets into the pit, he pushed himself beneath them, broke and shredded most of them with jaws and feet—Fabre says with his trident also—until his cell was lined with a thick coat of non-conducting material, inside which he lay snugly all the winter through, feeding upon the unbroken pellets at intervals.

In spring he began to get restless, and to feel a desire to revisit the regions of light and air, so he scrambled up his blocked shaft and emerged upon the heath. His first thoughts were of fresh food; and he rose into the air and sought the sheep pasture. For two nights he fed to repletion; and then another impulse moved him. He came across a shaft in which a neat little female of his own kind was working strenuously, and he offered gallantly to lighten her labour by taking a turn at the digging. She neither accepted nor declined his offer, but intimated that it was her job, and that she must get on with it! Then he saw that another trident-bearer was approaching on the far side of the pit, and it was evident that the new-comer was about to seek the favour of the lady digger. Each male resented the presence of the other, and sought to intimidate his rival by butting and buffeting, but they both failed to inflict any damage, thanks to their heavy armour. The lady raised her head above the edge of her excavation occasionally, and at length, appreciating the reason for the scrimmage, intimated to the first-comer that she accepted the help he had offered. The other slunk away.

*Photos: Edward Step, F.L.S.*

*Inset*—The female Trident-bearer (*Geotrupes typhœus*) has no very obvious suggestion of the formidable-looking trident which distinguishes the male. Her fore-body shows merely the beginnings of the lateral spines. (*Natural size.*)

A handsome little fellow is the male Trident-bearer. He is three-quarters of an inch in length, and his powerful bristly legs have stout tooth-like projections along the outer edge. But his characteristic feature is his three solid spines (× 4).

The further action of the story takes place underground. It was something of a mystery to the naturalist until the patient French observer, Fabre, set himself to dis-

cover the facts, the trident-bearer being a native of France as well as of southern and middle England. Some of his observations, it is true, are of the behaviour of the beetle under restraint, and such observations are always more or less open to question, for we can never be sure how far intelligent wild creatures in confinement will modify their normal methods to fit the changed environment. Fabre also limits the scope of the trident-bearer's activities to an extent that is not justified by the experience of English coleopterists.

*Photo: Edward Step, F.L.S.*

The labours of digging a pit on the part of the female Trident-bearer became the object of a little courtship episode on the part of two males. The lady raised her head above the edge of her excavation occasionally, and at length intimated to the first-comer her acceptance of his offered help.

Except in the autumn, when the sexes appear to be about equal in numbers, the female is rarely seen without digging her out from her retreat. In attempting to find the missing females in spring, Fabre's trowel soon became useless, for the perpendicular tunnels extended far beyond the reach of a one-hand implement. On employing the spade they were found to extend to a depth of five or six feet. These deep shafts are excavated entirely by the females, who begin them in autumn when the males are sinking their own shallow retreats. But the female's shafts are not always as deep as in Fabre's experience.

The duty of the male is restricted at first to carrying up to the pit-mouth the material his wife has displaced in her mining. It was here that Fabre discovered a use for the trident of the male. He uses it as a hod, the better to retain his load. With it he scoops up the dug-out soil, and with as much as it will support he climbs the ever-lengthening shaft and shoots it around the pit-mouth. It is true that in other volumes of his *Souvenirs* Fabre variously asserts that the trident is (1) of no use, and (2) that it is used for breaking up the food pellets. Other members of the scarab family are able to accomplish the earth-carrying without the assistance of trident-hods, and we can only assume that the trident-bearer has developed these horns as an improvement upon the outfit of his congeners.

When a sufficient depth has been reached, a chamber is excavated, and the male transfers his operations to the surface, where he rolls dry pellets to the pit-mouth, breaks them up and drops the fragments down the shaft. Here they are further divided by the female, who kneads them into a sausage about three inches long and half an inch thick, and lays an egg in the soil near one end of the sausage. A separate sausage is prepared for each egg laid, the mother knowing to a nicety how much food the grub that emerges from the egg will require. Ten days is the average time required for the elaboration of each sausage. The sinking of the shaft and the digging of the first cell is the work of three or four weeks. During the whole of this period no food is taken by either of the miners!

(1) (2)

(1) Larva of *Geotrupes typhœus* in its cell awaiting pupation. (× 1.) (2) Female pupa newly formed. (× 1.)

(3) (4)

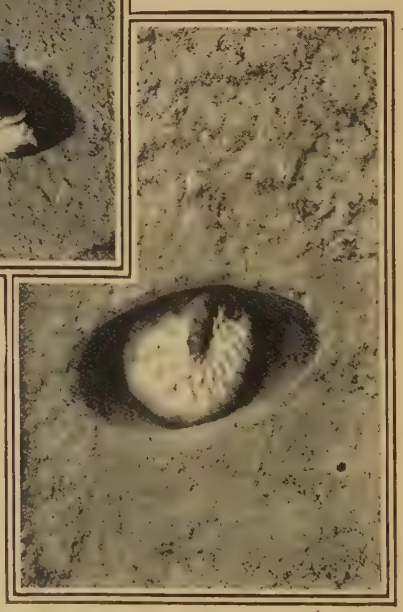
(3) Female pupa in the mature state. (× 1.) (4) Female Beetle ready to leave pupation cell. (× 1.)

*Photos: Hugh Main, B.Sc., F.E.S.*

**THE TRIDENT-BEARER IN FOUR STAGES OF DEVELOPMENT.**

In nearly the entire range of insect life it is the rule for the sexes to separate after pairing. The male does not survive his marriage by many days ; the female lives to make provision for the perpetuation of the species. Among the dung-beetles we find the exceptional habit of a couple remaining together, and sharing the labours of providing for their progeny, much as though they were birds. But the male has not the staying-power of his partner ; as spring wears on he feels that he has done all that Nature fitted him out to do. Climbing out of the shaft he crawls far away and, spreading out his limbs on the sunny turf, dies. In May or June dozens of these dead males may be found in suitable localities, for they appear to make a point of never dying in or near the burrows.

Male pupa of *Geotrupes typhœus* in pupation chamber. (× 1.)



*Photos : Hugh Main B.Sc., F.E.S.*

Full-grown larva of *Geotrupes typhœus* in the act of making its cell. The sinking of the shaft and the former operation occupies some three or four weeks. (× 1.)

The female lives on until all her eggs are laid in branches from the main shaft, with a sausage elaborated for each of the future grubs. The egg hatches in about four weeks, and the young larva creeps from its covering of sand into the cell and bores into the sausage. It finishes its task about the end of August, when it is much like the well-known larvæ of the cockchafer and the rose-chafer, with the bloated hind body bent under it. Full-fed, it descends its shaft again and at the bottom hollows out a cavity and plasters the walls smoothly with the contents of its intestine, long retained for the purpose. The grub becomes a chrysalis in which sex is indicated by the presence or absence of the trident. About a month later, the perfect beetles appear for a time above ground.

Fabre says that the trident-bearer "works exclusively with sheep-droppings." However true this may be in his beloved Provence, it is not the fact in Britain. I have found the beetles and their shafts here by the sand-pit where nothing suitable but rabbit-droppings could be had, and the land around for many acres is covered with heather, through which it would be impossible to roll pellets from a distance. But it is found also under the droppings of horse, cow or deer.

Our other large dung-beetles, of which Shakespeare's " shard-borne beetle," more familiarly known as the " lousy watchman " (*Geotrupes stercorarius*), is a well-known example, have a more primitive—or perhaps more advanced because labour saving—method of providing for the next generation. They seek the natural heaps of manure, and dig their shallow pits immediately below. None of these bears horny outgrowths analogous to the trident, so that the male trident-bearer, when found, provides his certificate of identity for all to see.

*Photo: J. T. Newman.*

As a night songster the Nightingale is acknowledged by all to be supreme. It is while awaiting the coming of the hens, and while he is singing for them, that he learns the magic song we know so well.

# 24.—SONGSTERS OF THE NIGHT

By EDWARD C. ASH, M.R.A.C., F.R.M.S.

THERE is something extremely fascinating and eerie in the sounds of bird life at night. The stillness of the countryside added to the darkness imports a meaning and an interest into noises which in the daytime would assuredly pass unnoticed. The nightingale, for instance, is often considered to be solely a night bird, yet it also sings when the sun is up, but its song then, except for quick ears, is smothered in the general chorus.

On the other hand, many of the so-called day birds are abroad and busy well before dawn. That veritable babel of song which opens at daybreak on any summer morning has its prelude in earlier twitterings that are more than a mere tuning-up of the orchestra. The lark, eager to begin, rises even before his proverbial self, and is to be heard any May morning heralding sunrise with his merry song. Swallows, too, twitter before it is light. The swifts love to play against a background of deep, black sky, and as they race through the air, their keen, shrieking note is easily distinguished by the listener. Nevertheless, these are not night birds in the fullest sense, and we have to mark them off from those which habitually haunt the watches of the night.

Of these latter the nightingale is

acknowledged by all to be supreme. Poets have sung his praises and have described, in language which I cannot hope to emulate, the intense beauty of his song and its setting. In some retired grove, its shadows heightened by the moon-blanched open spaces, this bird sits in its solitude and pours forth its rich but penetrating and plaintive volume of song.

Arriving in south-eastern England in April, the nightingale male bird impatiently awaits the coming of the hens, and it is while he is singing for them that he learns the magic song we know so well. It is acquired bit by bit, note by note. He calls *tu*, *tu*, *tu*, *tu*, hoping and hoping no doubt to get the right note, the most perfect note, before his wife arrives. With endless patience he tries it over and over again, and when he gets it proceeds systematically to the next. *Twee*, *twee*, *twee*, *twee* he recites, slowly at first, and then suddenly quickening the pace, repeats *twee-twee-twee* until it rattles in his throat. Now it is *who*, *who*, *who*, with the tone rising and the volume of sound increasing, until finally he ends his practice with a rapidly repeated *twit*, *twit*, *twit*, *twit*.

As he sings he stops sometimes to listen to the song of another bird, or perhaps to think over his own efforts, and after he has finished his *tu*, *tu*, *tu*, *tu*, he waits. Yes, there a mile away is some other bird singing, and he has to wait until the stranger has stopped before he can start again. Often his notes are intermixed with other sounds: the croaking as of a frog, or peculiar sneezing, hissing noises unaccountable and out of tune with all the rest. When the nightingale has finally acquired his proper note he sings with a depth, power, and mellowness that few, if any, other birds can equal.

*Photo: Benjamin Hanley.*

The Nightjar, at intervals during the nocturnal hunt for insect food, will rest lengthwise on the branch of a tree; by day the bird will perch on trees or hide in the bracken.

At night, when in full song, the nightingale fears nothing. He sits in a bush, his throat distended, his beak wide open, the feathers round his neck quivering, and his whole being vibrating with his effort. You can then walk up to him or even flash a lamp in

Photo: Henry W...

THE LONG-EARED OWL ON HIS NIGHTLY VIGIL.

To track down this bird in his haunts, one must wander in a pine forest or in a beech wood on a moonlit night.

his face, without in any way disturbing his love song. He is too occupied, too interested, too much in love, to care either for you or your light. Or perhaps he is singing to outrival all those whose songs come to him from afar. Or maybe he is singing to his consort, who by this time has arrived and is now sitting on a nest of eggs in the side of the bank.

Photo: Alfred Taylor.

The Tawny Owl will perch among the ivy or on the top of a polled tree in the hills, moaning out his challenge to the silent night.

When the young have been hatched from the eggs the nightingale sings no longer, but croaks in low, curious, almost unpleasant tones. Before August is out he and his wife and family have departed.

I remember as a boy once hearing a bird serenading below my window, its song resembling a policeman's whistle mingled with the sound made by whirling a whip-cord. It terrified me, but later, when I understood that these strange noises were from a nightjar singing to his mate, I became curious to know more of this musician.

The nightjar is an elusive bird and rather ghost-like in its habits. Should one chance to meet it on the wing, all that will be seen is a black object floating quietly along the ground and soaring over a hedge, silently and without effort, or at times making with its wings a cracking sound as if two pieces of wood were slapped together, as strange and eerie in flight as in voice. At rest he sits lengthwise on the branch of a tree, a black lump against the moon, whirring his cacophonous song.

Nightjars are insect eaters, their food being moths and beetles. These they catch in their claws at night and place in their large beak, which is capable of holding huge supplies. During the day these birds hide in the bracken or perch on trees, but as soon as the light fails they start hunting again.

Of all the sounds at night, I know of few which can awaken deeper emotions or which are less easily forgotten than the wild, sad, penetrating cry of the tawny owl among the mountains. It will stand on the top of a polled tree on the hill slope and call *tu-hu*, *tu*, *tu*, *tu*, *tu*, *hoo* over and over again. And somewhere else on the mountainside another owl will answer, moaning out its challenge, until the hills carry the voices from one to another, driving the sound to and fro like a shuttlecock, until at long last it dies down.

To track the short-eared and long-eared owls to their haunts one must wander in a forest of pines or in a beech wood, preferably on a moonlit night when a mist is hanging thick between the trees. With luck one may catch sight of a grey form as it flaps slowly away. If young owls are present, their snore will be heard, a sound like that of an engine letting off steam at regular intervals, or a deep hiss, as though they were telling the intruder to be quiet. The barn owl has a call like *ke-we*, which is often to be heard after the sun is set.

But for the most part these night birds of the inland regions are solitary, and we have to go to the mud-flats of the coast to find communities of birds filling the night air

*Photo: Capt. H. Morrey Salmon, M.C.*

Somewhere away on the marshes the Redshank wakes up and calls in plaintive tones—

*Photo: Peter Webster.*

—while from the lower reaches of the river, when the mud-flats are flooded with silver, comes the quacking of Mallards and a medley of other birds' voices.

with their cries. Few things are so fascinating as the sounds coming from the marshes at night, when the whole scene is lit up by the moon and the reaches of mud and tidal river are flooded with silver.

Curlew wail somewhere on the dark mud-flats, a redshank wakes up and calls in plain-

*A. M. C. Nicholl, M.B.O.U.*

The Reed Warbler wakens the night hours with his weird grating song which is without rhythm, rhyme or reason.

tive tones, and every now and again the musical notes of waders are interrupted by the grating alarm notes of snipe. If it is autumn there may also be the curious cry of widgeon, which talk and call to each other out of the darkness.

As the tides wash the fowl from the lower reaches of the river, causing them to seek higher spots, the air will all at once be alive with their whistles and cries : the *twee-twee-you* of widgeon, the honking of geese, and the quacking of the mallard, the hoarse cries of the herons as they rise on their wings. Often in the medley of bird voices there comes a wild mad laugh, a note sounded high above the rest of this marsh orchestra. It is a gull, and as he laughs he wakens thousands of others, who laugh in chorus, until the air is mad with tumult. Then, just as suddenly, all is still, and the only sounds are the quiet lapping of the water and the occasional cry of a curlew or whimbrel. Or a plover, wheeling about in the darkness, as though lost and uncertain where to alight, calls plaintively to its mates, hoping to get direction, and calling as if afraid to make too much noise.

In curious contrast to the wild free voices of the people of the muds is the pathetic tinny song of the reed warblers in the reed beds over the wall. The reed warbler wakes from a deep sleep to sing his weird, grating song which is without rhythm, rhyme or reason. It is the oddest medley of broken notes, peculiar whistles and loud hisses. It would seem almost as if the bird knew what a miserable attempt it was making and was hissing at its own efforts. He wakes up and mutters *twi-phang-whiz-bang-we—hiss ! hiss !* and then goes to sleep again.

The marsh warblers also wake up in the night and sing their melody, which is a curious mixture of the cries and calls of many other birds.

Not many years ago the booming of the bittern was a common sound of the marshes, and even now one may be fortunate enough some evening to hear its deep penetrating call like the clanging of a muffled bell.

So the night has many voices, and with its dream-like mists—its alternation of shadow and moonlight—is ever full of wonder and beauty, and the very silence serves to make more lovely those songs and calls that ever and again awaken the darkness.

*Photo: C. J. King.*

During the breeding season one occasionally sees the Manx Shearwater sitting at the mouth of the nesting-hole. To those unacquainted with the behaviour of these birds, even on an island which boasts a large colony, this rarity may seem curious.

# 25.—THE MANX SHEARWATER

By C. J. KING

DESPITE the strides which our knowledge has made of late years, the Manx shearwater is one of those birds about which ornithologists are still to some extent uninformed, and there is no bird in the British avi-fauna which, as far as I know, has been less photographed. The habits of this bird are such as to make both observation and photography difficult. During the greater part of the year it spends its time at sea, ceaselessly skimming the waves, as its name implies; feeding upon molluscs and other minute creatures of the ocean's surface, and seldom coming to the shore. But during the breeding season things are changed. At this time the birds —the male and the female—take daily turns of about twenty hours each in their nesting-holes, one bird being occupied in incubation while the other is roaming the adjacent seas. Here in the Scillies, where I have spent over thirty years observing sea-birds, we have one of the largest known colonies of the Manx shearwater, and perhaps if I take this particular colony on Annet as typical, and describe the behaviour of the Manx shearwaters there, I shall not go far wrong, as from what I can learn these birds behave in the same manner in all their known breeding places.

Imagine, then, an island of about half a mile in length, somewhat snakelike in form, with various small bays (almost cut in two by them in places), but widening out in other parts to perhaps two or three hundred yards, covered all over with either thrift, bracken or thick rank grass, the fringe rocky all round, and with the exception of a gentle rise towards the broader end, comparatively flat. This, among dozens of others, is the one selected islet on which the Manx shearwater has for hundreds of years taken up its abode. But these birds do not occupy the whole of Annet. Though

*Photo: Peter Webster.*

The Manx Shearwater's one egg is white and similar in size to that of the ordinary domestic fowl. It is incubated well away inside the nesting-hole.

there are many thousands of them nesting here year after year, and there is other soil which seems equally suitable for their purpose, yet there are parts of the island in which no shearwaters are ever found. Why they should restrict themselves to one island, and to certain parts of one island, remains yet to be decided, but so it is.

If one unfamiliar with the habits of this bird were to visit Annet during the breeding season, it is quite conceivable that the whole day might be spent there without a single shearwater being seen; in fact, I have often spent the day there without seeing one. Occasionally, but very seldom, a bird may be seen at the mouth of a nesting-hole, or, as once happened to me, a sight of a fight between two birds in a similar position; but these are quite exceptional, and the only way really to see the shearwaters is to spend the night with them. Such an experience I will describe later on.

The flight of the shearwater is most graceful. Without effort the bird glides over the surface of the water, turns, rises or falls almost without movement of the wings; but it seldom ascends to any great height. It is a beautiful sight to see these birds in large numbers, hundreds of them together, and frequently even in thousands, wheeling about over a smooth summer sea, but never colliding. The one egg of the shearwater is white and of about the same size as that of the ordinary domestic fowl. Incubation takes place well away inside the nesting-hole, and out of sight. This accounts for the fact already mentioned that the bird is seldom seen while sitting. The nesting-holes vary in length from one or two feet up to almost any distance, as where the birds are very numerous and the soil is soft and sandy, the burrows intersect one another in all directions, and this, no doubt, accounts for the occasional fights which take place when a bird finds some intruder in its home. In

*Photo: C. J. King.*

On land the Manx Shearwater is a helpless, clumsy bird. The legs are set so far back that they seem of little use for walking. It is only by bundling along the ground, or flapping up on to a rock that it seems able to take flight.

*Photo: Peter Webster.*

The young Manx Shearwater is covered with down. It looks quite as helpless on land as, indeed, it proves to be.

some places the shearwaters are in very close proximity to the puffins, but they seldom cross each other's burrow, or if they do, I think the shearwater gives way to the smaller bird with the formidable beak. I have never seen the two species fighting.

The shearwater on land is a helpless, clumsy bird, with its legs set so far back that they seem of little use for walking, and it is only by bundling along the ground in a haphazard sort of way, or flapping up on to a rock, that it seems able to take flight. This is no doubt the reason why so many of them fall a prey to the various gulls; indeed, when one visits Annet towards the end of the nesting season, the sight presented is most repulsive. In all directions are the emptied bodies of shearwaters and puffins.

*Photo: Peter Webster.*

The adult Shearwater after spending the greater part of the day at sea returns to its solitary chick.

I purposely use the word " emptied," for what happens is this. The gull—generally the greater black back—watches near the smaller bird's nesting-hole, and as soon as the latter shows itself, the gull seizes it by the back of the neck and shakes it as a dog shakes a rat. The little bird may be killed outright, or it may be only slightly hurt ; in the latter case the gull will often play with it, allowing it to flap, or run, a yard or so, and then catch it again, and so worry it to death. But sometimes, not being badly injured at the outset, it gets away altogether. This, however, seldom happens, the rule being that the big bird finishes its horrible work by disembowelling its victim, swallowing the viscera and leaving the empty carcass to rot in the sun. But occasionally, when, I suppose, the gull is very hungry, it will swallow the whole bird, head included. This I have proved by collecting shearwater and puffin heads amongst the castings scattered round the nest of the greater black-backed gulls.

*Photo : Peter Webster.*

For the greater part of the year the Manx Shearwater spends its time at sea : during the breeding season the male and female take daily turns of about twenty hours each in the nesting-hole while the other roams the adjacent seas.

The nightly frolic of the shearwaters is one of the most interesting of Nature studies, and should be watched by all bird lovers who have the opportunity. It means a night in the open air, but it is at a time of year when this is in no way a discomfort, in fact, just the reverse. Just about ten o'clock —by the sun—the birds will be seen coming out of their holes in the dim, fading light, and in less than half an hour hundreds of them will have emerged. While these have been leaving the nesting-holes the birds from the sea will have been coming in, until within an hour the sky will be thick with them, and the noise deafening. In all directions, before the darkness becomes too great to see them, they will show against the sky in numbers probably running into thousands. So close to the earth do many of them fly that it is wise to lie or sit upon the ground and watch them, for they flap one's face with their wings as they fly, and sometimes administer a nasty blow as they come with a rush against one's head. For about three hours almost to the minute this babel of sound and wild rush of wings continues, and then, as suddenly as it began, all is quiet. The birds which had spent the day at sea have taken their places in the nesting-holes, and those which had persistently done their incubating duty take their turn of freedom on the broad bosom of the Atlantic until night comes again, when the whole business is repeated.

The oceanic wanderings of this shearwater have yet to be definitely determined ; but that many of them remain in the Scillies throughout the year is proved by the fact that their peculiar cry is often heard on dark nights throughout the winter months.

I think, perhaps, that the occasion on which I have been most impressed by the shearwaters was once when I was proceeding at 4 a.m. (Greenwich time) to the wreck of a liner which had during the night gone ashore on one of the treacherous rocks with which the Scillies are fringed. Just before the sun made its appearance in the north-east the colouring was gorgeous, and as it peeped out of the sea amongst the Scillonian eastern group, the steam launch ran into a mass of shearwaters. We were completely surrounded by them ; they were an innumerable host, and the gambols of the graceful birds as they wheeled and turned and skimmed the blood-red sea made an impression not easy to forget.

*Photo: H. Mortimer and Wm. B. Batten.*

It would be a dull British summer without the Song-thrush. During the nesting season it is rather uncommon to see both parent Thrushes so advantageously placed at the nest in the care of the brood.

# 26.—OUR RESIDENT THRUSHES: Song-thrush, Blackbird, and Missel-thrush

By FRANK BONNETT

IT would be a dull world without birds, and least of all could we in this country spare that most persistent of British songsters, the throstle or song-thrush. He is even more familiar, perhaps, than the blackbird, and certainly better known than his larger cousin, the missel-thrush or stormcock. The whole of this merry trio —for surely they are among the most light-hearted of birds—belong to the resident species of thrushes, and their ways of life are very much the same.

Each of these three is a singer of merit, though it would be difficult to decide which of them is actually the best. It may safely be declared that the song-thrush has the most-varied repertoire. His season of song also has no fixed limit, as is the case with most other birds, for he may be heard, spasmodic though he be, in every month of the year. Even as these words are written, at three o'clock on a dark November day, when the fog is so dense that nothing can be seen at fifty yards' distance, there is a thrush in the orchard yonder shouting out his song as merrily as if the blue sky of May were overhead and the bough on which he sits garlanded with apple-blossom instead of cold, wet drops.

The song-thrush, indeed, refuses to be suppressed even by those dismal conditions which drive other birds into silence. The

robin at such times may just have the heart to keep him company, pouring out his watery little notes in brief snatches ; but the thrush's song is bold, defiant and complete, and seems to come, just as it does in happier days, circumstances he can always find it in him to sing a few notes, if only now and again.

At the turn of the year his song of happiness will become stronger and more frequent, until at the approach of the nesting season

*Photo: L. J. Langford.*

The female Song-thrush just arrived at the nest with food for the young. While the cares of the family are full upon him, the male does not give up song entirely.

from his very soul. To-morrow morning the fog may have lifted and rain be falling, or the sky may have cleared and the land be covered with a thick, white frost, but the thrush, nothing daunted, will be singing just the same. Sooner or later, just because he cannot help it, he will break into melody. In winter, however, not even the thrush can be expected to carol for hours on end, as he does in the springtime when his heart is filled to the brim with the joy of the living year, but it is to his credit and points to a happy disposition that in the most dismal we shall hear him at his best. For then, be it remembered, there will be many rivals in the field, and who shall say that a thrush does not win his bride as much by vocal prowess as by the smartness of his coat ? Later on, when the cares of a family are upon him, he will have less time for the idleness of song, but he will never, like the nightingale, give up entirely, even though the exigencies of food-hunting for himself and family shall keep him busy for the greater part of the daylight hours. He rises early and goes late to bed, so that in

A WOODLAND IDYLL

Song-thrush feeding her young at sunrise

*Photograph by J. T. Newman*

FATHER TAKES A TURN

Male Song-thrush feeding the youngsters

WAITING FOR MOTHER

Young Blackbirds

"I'M ALL ALONE!"

Young Missel Thrush

*Photograph by Stanley Crook*

*Photo: T. M. Blackman.*

**A FEMALE SONG-THRUSH ON THE NEST.**

The female Song-thrush will sit closely on the eggs for considerable spells, while her mate sings unceasingly in the boughs above.

the morning he may often be heard singing before the lark has made his first ascent, and at sunset even after the robin—another keeper of late hours—has sung himself to sleep.

It is only during a brief period of the summer—in July or August, when the days are hot and dry—that the thrush relapses more or less into silence; the first shower or the coming of cooler autumn days will usually cause him to break out afresh. The cares of life would seem to sit lightly on the thrush's shoulders, for it is only when the weather is at one or other of its great extremes that he is reduced to really serious mood.

There are times, indeed, when even the hardy song-thrush and other members of his family find life harder than they can bear. In a long drought food is apt to be scarce, and even though the older members of the tribe may be able to eke out an existence on the forbidden fruit of garden and orchard, the younger generation, to whom insect food is a greater necessity, have a hard struggle to live. Worse is it when a hard winter—possibly with a short crop of hedgerow fruits—holds the land in a grip of iron for days or even weeks on end; for then the food supply, despite the most diligent search for unconsidered trifles in the more sheltered places, is bound to fail, and the death-roll must be heavy. Despite time-honoured belief, there is no connexion at all between a hard winter and plenty of berries, for the latter are a result of the season that has gone before, not an indication of the days to come. There are hard winters when the crop of wild fruits is negligible, or it may be that frost and snow do not arrive until all the natural food of this description is exhausted. So, sometimes, though happily at long intervals, the downs and fields are strewn with sad evidence of starvation among the birds, and the thrushes are the worst sufferers of all.

*Photo: T. M. Blackman.*

The nest of the Missel-thrush is compacted of fine twigs, grass, stems, moss, and mud, and lined with fine dry grass. It is usually situated at a considerable height and in a strong fork, or at the junction of two or more branches.

Like his smaller relative, the missel-thrush is another brave and persistent songster, but his voice, though usually more powerful, is harsher and much more limited in compass. His singing is confined mostly to the first four months of the year, but he may be heard at intervals both earlier and later. Usually it is about Christmas he is heard for the first time, but now and again he will take us by surprise by uttering a few rather subdued notes in the autumn—on which occasions, possibly, we may be listening to a young bird making a preliminary test of his vocal powers.

*Photo: F. Jefferson.*

**THE MISSEL-THRUSH.**

It is one of the earliest of British nesting birds. Even in March he will sing through the fiercest gale, and in consequence of this sturdy defiance of the weather he has earned the alternative name of "stormcock."

The missel-thrush, of course, gets his nickname of "stormcock" from the fact that in the breezy days of March he will shout defiance to the fiercest gale. The harder it blows, the more he seems to enjoy it. He is an early-nesting bird, and once the young are hatched, devotes himself so attentively to domestic matters that he has but little time for singing. When, however, a few weeks later, he once more takes his perch upon the tree-top and sings aloud, it is a sure sign that another family of missel-thrushes is launched into the world. That is not to say that he and his mate wash their hands of their offspring as soon as the latter are able to shift for themselves. The whole family keeps in touch all through the summer, and presently may be seen with other families of their kind congregated together in the meadows or wherever food is to be found. There they will remain until the approach of another season warns them that it is time for family parties to be broken up.

*Photo: Stanley Crook.*

A young Missel-thrush never loses touch with his parents and the family throughout the summer, even when another brood is being launched on the world. Family parties continue to meet on the feeding grounds, until the inevitable separation of another season.

Not until the signs of spring are well advanced will the blackbird condescend to make music at his best—and the blackbird's best is very good. Scarce a note will he utter until long after the days have begun to lengthen, but sometimes towards the end of January he will begin to try his voice, if so be there is a feeling of springtime in the air and a still, clear evening gives promise of a fine day on the morrow. Unlike the missel-thrush, the blackbird has no fondness for wild, wintry weather. With him, singing is largely, though not entirely, a matter of temperature, and he loves the sun. But he is much more of a sentimentalist than either of his cousins, and that is why, perhaps, he prefers to save his song until the bustle of the day is over and the stillness of evening provides a more fitting accompaniment to the emotion of his soul. Serenity is the thing that most appeals to his feelings—so much so that even though the air strike chilly, his buoyant spirit seems as though it must respond when all around is fair.

That is in the early days of the year—at such times when stern January or fickle February may be in relenting mood; or in March, when that often boisterous month forgets its anger and gives us a day of which

even May might well be proud. Later on, when the sun has gained real power, and the wind blows softly from the west or south, the blackbird is at last in his element, and day after day will whistle merrily from one of his favourite perches until dusk begins to fall. He is not a really late singer like the thrush, nor is he so fond of high places. Now and again, when in exuberant mood, he will select a point of vantage on the house-top, but more commonly he prefers to remain hidden in the seclusion of some evergreen tree or bush where he can see without being seen. He is for ever a suspicious bird, and his nerves are easily upset, as may be known when with loud cries of alarm he scurries from bush to bush—a sure sign that Grimalkin or some other soft-footed prowler is abroad.

### The Blackbird's Song

As in the case of the nightingale and all other birds noted for their song, the excellence of the blackbird's singing depends much on the individual. Some are real artists, others can never aspire to concert standard. The song-thrush may claim to a more varied repertoire, but when it comes to quality of tone and expression, it is the blackbird that bears the palm. His notes are much more mellow, and he sings in a lower and more tuneful key. The thrush, like the exuberant butcher-boy, sometimes allows himself to whistle in too shrill a key, but the blackbird rarely descends to such vulgarity. His smooth and well-rounded notes are more reminiscent of the skilled and perfectly-trained performer. One need have no more than a smattering of musical knowledge to appreciate the better quality and the more pleasing expression of the blackbird's song. For all that, it is apt to be eccentric and almost surprising at times. Some peculiar characteristic of this kind is often to be noticed in a particular bird, so that it is impossible to mistake it for any other. The song ends abruptly, or breaks off in such a manner as one would least expect. The blackbird, unlike its cousins, is also something of a mimic, and even in the wild state will learn to imitate a human whistle or some sound that it is in the habit of hearing. A wild blackbird which the writer knew quite intimately some years ago could reproduce to perfection the first line of " Here we go round the mulberry bush," though whether he did this by accident or design cannot be said. Another, which stayed about the garden for several years, so closely copied the family whistle of three notes that one or other of us frequently answered him in the belief that some other member of the family was calling.

The different songs of song-thrush, blackbird and missel-thrush, which are familiar enough to the practised ear to be readily recognized, are not so easily identified by the ordinary observer, but there is little difficulty once the chief points have been mastered. The song-thrush always repeats himself, uttering usually from one to four separate notes in quick succession, and repeating those notes rapidly three or four times. After a short interval he changes to another set of notes, repeating these again a few times, and so on. He may ring the changes several times before he comes back to the set he began with, and his voice is usually pitched in a high key. The blackbird, on the other hand, whistles a complete set of notes—perhaps six or eight at a stretch—at a much more leisurely pace, and allows a considerable interval to elapse before he begins again. He may then repeat the same set, though invariably with slight variation. More often, however, he will select a different set altogether—though about the same in number—after which he will be silent again for an appreciable space of time. So he goes on, eventually returning to his original selection, which in the case of a poor performer may be the foundation of his whole repertoire.

### How the Missel-thrush Sings

The theme of the missel-thrush's song is much the same as that of the blackbird, though with shorter intervals between each snatch—for his is a wilder and more abrupt delivery in most cases. Nor has he any such good idea of putting his notes together or finishing them off in such pleasing fashion. He starts off bravely enough, but has a habit of breaking off suddenly as if he had made a mistake; and then, after waiting a little, has another try. Like the blackbird, he usually varies his song each time, and never, like the song-thrush, repeats a few notes in quick succession. His song, in fact, is careless and happy-go-lucky

all through, but he is so evidently enjoying himself all the time that the effect, if wild and sometimes harsh, is none the less cheering. His song, too, is all the more welcome in that it is so often to be heard when other birds are silent.

All the more extraordinary is it, therefore, that the missel-thrush should so often have been declared to have no song—even by those who have given a certain amount of study to birds in general. One can only suppose that such persons are unable to distinguish between the song of the storm-cock and that of the common thrush. Or is it that they confuse the refrain of the former with the blackbird's much more melodious tones? In either case it is difficult to understand, yet it is no easy matter to convince any one of these disbelievers that he is wrong. The time-honoured nickname of the missel-thrush should alone be sufficient to convince the most sceptical not only that he sings, but that his merry accents are not to be overridden even by the wildest storms of many-weathered March.

Both song-thrush and blackbird are to be reckoned useful birds in the garden, despite the fact that each of them has a weakness for fruit in season. This latter desire, however, is much more marked in the birds of the year, to whom this kind of diet seems to be a greater necessity than to the older generation. Every gardener should find it in his heart, none the less, to overlook these little peccadilloes, for during the greater part of the year the thrush and the blackbird are his most devoted helpers. The former especially is the active enemy of the snail.

The blackbird is not so ardent a snail-hunter, but, like his cousin, is for ever in search of insect fare. He will devour grubs and caterpillars and the larvæ of every garden pest as well as the more or less inoffensive earth-worm whose worst crime is that he makes the lawn unsightly with his "casts." The missel-thrush, too, is a bird of value to mankind. He does not worry the gardener much, though he will sometimes strip the mountain ash of its ruddy harvest all too soon; nor is he so fond of seeking his insect fare in the garden as in the meadow or the field. In the latter places he does much good work for the farmer in ridding the soil of various pests.

*Photo: J. T. Newman.*

Serenity is the quality that appeals most to the Blackbird's feelings, and it is shared by parent and brood alike. These four young Blackbirds completely suggest this characteristic.

# Wild Flowers and Their Ways

## 10.—PLANTS AND THE WEATHER

By G. CLARKE NUTTALL, B.Sc.

With photographs by the Author

PLANTS have to reckon with the vagaries of the weather just as we do, and a sudden downpour of rain may be as disconcerting to their plans as it often is to ours. Chiefly their need is to guard the delicate stamens and their contents, the fertilizing pollen which frequently takes the form of fine floury dust and which would be utterly destroyed if the flowers became waterlogged. So we find that the plants have made all kinds of plans whereby injury due to the weather—by which we mean bad weather—may be avoided. It is true that some plants, like some people, appear not to mind adverse conditions, or perhaps they merely "chance it," and are philosophical if the odds turn against them; but the majority keep their "weather eye" open and guard their pollen by precautions which range from permanent sheltering to temporary expedients; and, throughout, the precautions taken against rain apply also to nightfall with its possible heavy dews.

Among the first set of flowers, namely those that provide permanent shelter, we have all such hanging bells as wild hyacinth, foxgloves, heather and the like. The rain pattering down falls quite harmlessly upon the outside of the bell, and all within is so dry and snug that many a little insect tramp takes refuge there on a cold wet night. It is worth noting here in how many cases, as for example the snowdrop, the bud stands upright, the full-blown flower bows its head, while the fruit is again erect. The rain cannot hurt the closed bud or the seed capsule, but it would injure an upright flower, hence the varying attitudes.

In hanging flowers such as the Foxglove, the stamens are always under shelter and dry. Rain pours harmlessly off the outside of the bells.

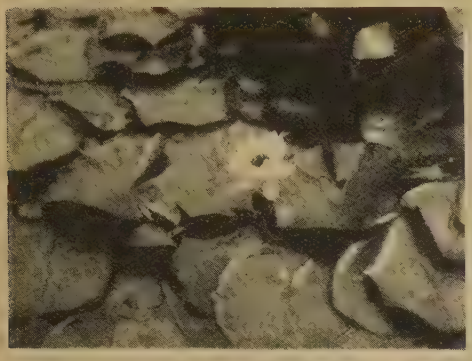
Other flowers are immune from hurt because they are closed boxes; such are the snapdragon and the toad-flax which no rain can possibly penetrate; while yet others provide a porch overhead to keep the stamens dry. Such a porch we see in the dead nettle—the black stamen heads being well under the white awning—and in this case shelter is doubly secured because the leaves also stretch out and shield the blossoms, as the photograph shows; indeed, there are a vast number of these two-lipped or "labiate" flowers that follow this method of protection—the thyme, sage, and common hedge stachys may be instanced. Then there are flowers such as the primrose which, though they always turn a bright face to all weathers, yet set a guard

by narrowing the lower part of their petals into a tube in which the stamens are hidden, and this—often further protected by hairs at the top—is practically rainproof.

But these permanent and immovable forms of protection do not appeal to all plants, and there are a number that meet spells of bad weather with temporary expedients, just as a man puts up an umbrella, wraps himself up in a mackintosh or takes cover in similar circumstances. The water-lily is one of these. Its large white rosettes with the golden centre are wide open in the sunshine, but towards evening, for fear of dew, and at the approach of rain, the white petals close over the centre only to unfold with daybreak or fine weather. When the flower closes it often becomes practically invisible among the leaves, so popular superstition said that it went under the water. But, of course, there is no real foundation for this idea; the green sepals merely wrap over the white petals and hide them.

The scarlet pimpernel is extremely sensitive to weather, like some of those apprehensive people who are so afraid of the slightest shower that they are always taking unnecessary precautions. The pimpernel closes not only for rain but at the passing of every harmless cloud, and has thereby earned the name of " the shepherd's, or the poor man's, weather glass "—though if one were guided by it one would be in a state of perpetual nervousness. It also definitely " goes to sleep " every day early in the afternoon, not to wake until eight or nine o'clock the next morning. The little blue germander speedwell is very like the pimpernel in its ways, and the star of Bethlehem (*Ornithogalum*), which is now counted among our British wild plants though more common in our gardens, is also weather-sensitive. It only comes out in the sunshine, and though it is very gay and starry when it does appear, it closes up into its green and white buds directly the sky clouds over, and long before the rain actually comes. The crocus and its brother the meadow saffron also close, and very wisely, or their deep, narrow cups

In the Dead Nettle the top petal forms a porch which keeps the opening into the flower quite dry. The leaves, too, make roofs over the flower clusters.



1.

2.

1. The Water-lily open in the daytime. 2. The Water-lily closing in the evening, when it tends to become so enclosed in its green sepals as to be almost invisible amongst the green leaves.

would speedily fill with water to the detriment of everything inside.

The golden winter aconite, that so gaily runs riot over our plantations in the earliest days of the New Year, has rather an interesting expedient of its own. In this flower the petals have changed into nectaries and the sepals, usually green in flowers, are coloured yellow like petals. There are many rings of stamens, and the heads of the outer ones shed their pollen first, the rest maturing in turn until the central ones are reached. The yellow sepals always curl over and protect the stamens when rain is about or night coming, but at first they are short and just curl over the outer ones, which, of course, is all that is really needed, but as the rings of ripening stamens get nearer and nearer the centre the sepals keep pace with them by growing longer and longer at nights, and so the pollen is always kept dry.

Everyone knows that the daisy is the "day's eye," opening by day and closing by night

The Star of Bethlehem in the rain, and in the sunshine.

and in wet weather. Here we have a halo of white rays surrounding a multitude of minute flowers set on a cushion at the end of the stalk, and this halo is not only an attractive advertisement luring insect visitors to the minute florets, it is also a guard and protection ever alert, when the sun withholds its gracious presence, to arch over and keep them snug and dry. Here again we find the rays growing as the rings of florets open successively towards the centre. What the exact mechanism is that produces this movement seems not quite clear. A great botanist suggests that the closed flower opens because the vibrations of light striking on the petals become partly changed into vibrations of heat, and the two, jointly acting upon the watery sap in the cells, bring about chemical changes that alter the tensions in the cells and promote growth. Further, it appears that the "wee, modest, crimson-tipped flower" has a deep-laid reason for the pink tips to the petals. They are not merely for a little added decoration, but are due to a substance known as anthocyanin, which has a special faculty of changing light into heat. They form the top of the dome-like covering when the flower is closed, and thus catch the full effect of dawn or returning sunshine and set the plant's mechanism in action. Sometimes one finds a daisy that will *not* go to sleep! This is invariably an old one whose day is done, and whose inner florets are all fertilized and therefore no longer in need of protection.

The Dandelion in the rain.

The same plant in the sunshine.

The dandelion bloom also opens and closes in the same cautious way as the daisy, folding its florets all together upwards. It is a good sleeper and begins to retire for the night very early in the evening, soon after five indeed, and does not "awake" until maybe seven in the morning—and this in midsummer days! The multitudinous hawkweeds and hawkbits may be classed with it, and in all cases the movement is for the protection from rain or dew of the tiny ball of pollen that each floret pushes out.

The carline thistle, dweller in arid wastes and seaside dunes, and called "a mournful

The Daisy in the sunshine.

The Daisy in the rain, and also when "sleeping" at night.

The open flower on the left is an old one whose day is done and therefore no longer needs to close for protection's sake.

Claytonia is a weathercock plant. In fine weather the flowers are widely open.

spectacle" by Linnæus because its very presence denotes barrenness, is like those people who can prophesy rain beforehand because they "feel the weather in their bones." So wonderfully sensitive is it to approaching rain that village folk use it as an infallible barometer. Here the shining rays that ring the central florets are merely scaly bracts, reddish outside and straw coloured within, and very hygroscopic—that is, they very quickly absorb moisture and as quickly give it up. Hence, when the air becomes moist with the coming storm, or the mists of evening rise, they immediately respond and close up, forming a reddish tent over the yellow florets in the middle, and the rain or dew runs off their shining surface as off a glass roof. As the air becomes drier again with returning sunshine, they, too, rapidly dry, roll back and spread like a golden halo.

Other flowers attain the same results by other means. Some there are who hold up cups to the sun, but they never under any conditions close them. Instead, they invert them, and show their indifference to the weather by literally turning their back upon it. The little herb Robert, the robin redbreast of plant life, is one of these. Come adverse weather, and it bows before the storm to rise after it has passed with true indomitable robin perkiness. The wood anemone, the lesser stitchwort, various campanulas and geums, the scabious heads and very many other plants are among those that bend over at night as well as in the rain. Some "go one better" still in that they both bend and close. Such careful precautions are taken by the fragile wood-sorrel, the delicate rock-roses and by the claytonia, a North American which has naturalized itself here now, and can no longer be counted an alien. Kerner has given the name of "weathercock plants" to those whose flower-stems rise and bend in this way. When one finds one of these flowers standing erect instead of bending in due season, be sure that flower is an old one whose pollen has been dispersed and has nothing left to live for.

In the rain Claytonia not only closes, but inverts its flowers to make protection doubly sure.

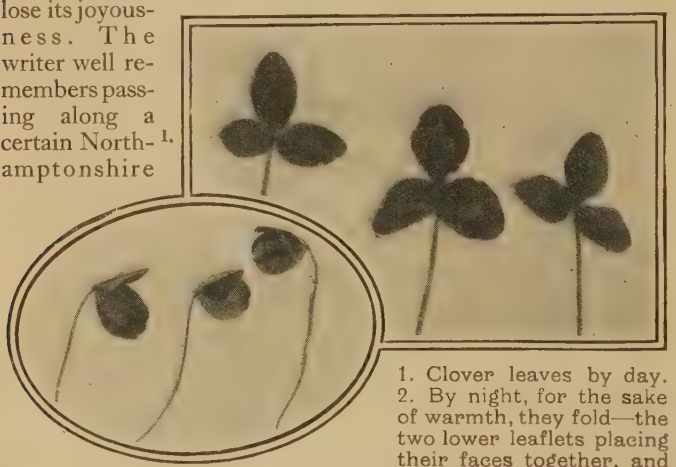
Even when flowers seem to flaunt defiance at bad weather, this defiance is often merely apparent and not real, and they are actually taking secret precautions that we do not suspect. The stamen heads, in which all pollen is produced, are really boxes that open by lids, slits, pores and such-like to allow the pollen to escape; and in certain flowers, in any moment of danger, the lids and pores close and the edges of the slits join together, so that, though the stamens are hanging out exposed to the rain, their pollen is being kept safe and dry inside their heads. This happens in the plantains, the lady's mantle, and the bastard toadflax, where the anthers close up within half a minute of being moistened.

The Geum is another weathercock plant. 1. Bending in the rain. 2. Upright in the sunshine.

In the Scotch thistle and the cornflower, though the pollen is shed

in due time, it is kept hidden in the tiny flowers until the limb of some visiting insect presses upon the spot where it is hidden, when it is promptly shot out upon the visitor. As insects, as a rule, only visit in fine weather, all is well.

The effect on the landscape of this response of flowers to weather conditions is often very marked. The contrasting photographs of the daisy, given here, show vividly what the scenic effect of even one small root can be, and when one surveys whole fields covered with endless flowers all acting more or less in concert, the general result must necessarily be remarkable. It is not only because the sky is grey that nature seems to lose its joyousness. The writer well remembers passing along a certain Northamptonshire lane where the roadside on either hand was a sheet of sapphire-blue speedwell—veronica. The flowers were particularly fine, just the colour of the sky above, and in the sunshine the whole lane was a wonderful revelation of " heavenly blueness." As one stopped to look one understood why the children call this plant " angels' eyes." But, passing back along the lane later when afternoon was merging into evening, and the sun had gone, one found it without colour or beauty—the wonder was that so ordinary a lane could ever have been thought attractive—and then one realized that every one of those " angels' eyes " had closed, for the time had come " when the blewart bears a pearl," as James Hogg, the Ettrick shepherd, said. The petals, brightest blue on the face, are pearly grey behind, so, as they fold together, the brilliancy hides from sight, and a grey round " pearl " stands in the place of each bright lovely flower. As this result was multiplied endlessly, there is no wonder the beauty had faded out of the lane.



1. Clover leaves by day. 2. By night, for the sake of warmth, they fold—the two lower leaflets placing their faces together, and the upper one roofing them over.

Again, a certain piece of waste dry land covered with dandelion roots was a joy to the eye on a certain sunshiny morning, so brilliant and numerous were the golden dandelion stars that faced the sunshine, but a heavy mid-day shower turned all the bright stars to mere yellow points and the land stood revealed as a bit of bare drabness of unmitigated ugliness. So, too, in our gardens, the cheerlessness of outlook upon a wet day is in a large measure due to the closing, drooping, or bending over of many of the flowers; thus the pansies droop, the nemesias huddle and go " dowdy," some of the composite flowers droop their rays, the big cistus flowers close, and so on. The fact that one does not usually choose wet weather in which to stand and closely observe Nature's ways has led to this point being much overlooked. We get the same obliteration of brightness, though, of course, in a much greater degree, when a sudden shower falls upon a gaily dressed crowd, the individuals of which immediately cover themselves with cloak and umbrella.

Among leaves there are a few, but only a few in this country, that take up day and night positions, chiefly to meet varying temperatures. Thus, in the clovers, bird's-foot trefoil, the melilots, medicks and the wood-sorrel, whose leaves are made up of three leaflets, we find the leaflets drooping and closing together as night falls. Note how prettily in the shamrock the two lower leaflets place their faces together while the third leaflet roofs them both over in motherly fashion. On the big acacia trees, too, the long leaves, made up of many oval leaflets, droop these leaflets towards dusk, so that they hang back to back and thus protect each other against the chills of night.

The silvery body of the Sea Trout shown by a front light. Careful observation is necessary to distinguish the Sea Trout from the sea-going Brown Trout. Both have similar scales, but differ in the arrangement of the teeth and certain appendages in the digestive track.

# 5.—THE SALMON FAMILY

By DR. FRANCIS WARD, F.Z.S.

With photographs by the Author

WE have already considered the salmon and the brown trout, and now propose to deal with the other members of the family which we shall call generally the salmonoids.

All salmonoids have a common origin. As we shall see by the examples here described, their primitive state is gradually modified so that variations of appearance and habit are brought about.

I have just looked into my copy of "British Fresh-water Fishes" by the Rev. W. Houghton, M.A., F.L.S., etc.; it is filled with beautiful illustrations.

This book has been out of print for many years, but I found what I wanted —illustrations and descriptions of the trout, in his various garbs, as described by former writers. Here is the list as given by Houghton: salmon trout, sewin, bull trout, Galway sea trout, common trout, black-finned trout, Loch Stennis

trout, Loch Leven trout, gillaroo trout, Great Lake trout.

There is a Swedish saying: "A favourite child has many names"—*the trout is a favourite child.* All the above names are the names of this favourite child—the common brown trout in disguise.

Trout, with the rest of the salmon family, can always be recognized as members of that family by the presence of the adipose fin—the small fatty fin behind the large fin on the back.

Yet, looking at the illustrations before me, it is hard to realize that the common brown trout can alter to such an extent, and then revert to his original appearance, when he returns to his usual habits and environment.

Environment is undoubtedly an important factor in the alteration of the appearance of fish. Yet the extent to which food is responsible for variation in the several disguises assumed by trout for defensive purposes in their constant underwater warfare, is not adequately recognized.

Bold markings and silvery iridescence are the extremes of alteration in appearance. Both can be acquired by food only. Of course, there is a scheme behind this. Either the trout must copy the pattern of his surroundings—mimicry—or he must reflect them.

To prove that this variation can occur as a result of food and food only, I give the following instance. On Mr. Richmond's fish farm at Shottermill are two ponds, less than two hundred yards apart.

Rainbow Trout under observation in the pond. Its prominent dark markings do not render it so conspicuous as might be imagined, except when seen against a perfectly uniformly shaded background.

These two ponds draw their water from the same supply, but the food in each happens to be of a totally different character. This accident—as accidents often do—gives useful information, in this instance on fish coloration. The upper pond abounds in water snails and other mollusca. The food in the lower pond consists almost entirely of crustaceans, water-fleas, daphnia, cyclops, etc.

Both these ponds were stocked at the same time from the same hatch of fish. Very soon, however, the fish in the upper pond became dark in colour, with intense red spots, and yellow below; those in the lower pond acquired a silvery appearance, shot with a pale pink hue. The

silvery appearance was due to a development of an excessive amount of light—reflecting spicules, on the scales of the fish, known as iridocytes; these iridocytes consist of guanin, derived from a rich crustacean diet. The peculiar pink shade that these fish had acquired was due to the masking of the colour cells in the skin by the excessive number of iridocytes.

When the brown trout goes to sea he has the opportunity of feeding on abundance of guanin-forming food, and so acquires a silvery appearance. Incidentally, this silvery appearance is his salvation, for it converts him into a mirror *when seen from under-water;* for he reflects his surroundings, and so by reflection is concealed from his enemies.

All the trout in Houghton's list are merely brown trout, masquerading.

At one time there were no trout in the Antipodes. Ova were sent over from England to Tasmania and New Zealand. Very soon the trout acquired sea-going habits, and after spending some time in the sea returned to fresh water to spawn as silvery fish, often weighing twenty pounds and more.

The silvery appearance of the Brown Trout converts him into a mirror when seen from under-water, and so by reflection conceals him from his enemies.

The young of these fish, if prevented from going back to sea, regain the habits and appearances of the ordinary common brown trout.

In British waters, bull trout are fish acting in the same way.

The Great Lake trout (*Salmo ferox*) is a cannibal pure and simple. The strongest evidence that this particular trout is merely a common brown trout veiling his identity, is that the young of the Great Lake trout do not exist.

A Loch Leven trout, if removed from the deep water of Loch Leven, again reverts to his brown trout garb, and his silvery coat with its black cross marks disappears.

The gillaroo of Ireland has large brilliant red spots on a flashing golden body. The lining of the stomach is also immensely thickened. What is the connexion? Food! In Loughs Melvin and Mask the main food is bivalves and other molluscs; this, as already explained, is the cause of the brilliant coloration of this fish. The thickened stomach-wall is developed to triturate their tough diet.

What about the salmon? He is a near relative of the trout, but years ago he took a line of his own. Every now and then one sees in the newspapers a paragraph headed "Salmon caught in the Thames," or, it may be, in some other waters equally uncongenial to the King of Fish. On inquiry, the fish reported on turns out to be a sea trout.

It does not require an expert to distinguish between these two fish; there is an infallible sign by which a small salmon or a grilse can be distinguished from a sea trout. In the salmon there are ten to twelve scales present, along an oblique line running forward from the root of the adipose fin to the lateral line—the line down each side of a fish where every scale is perforated with a vent-hole. In the sea trout, the scales number fourteen.

The char is a near relative of the trout. In Great Britain it is found mainly in the Lake District, and particularly in Lake

Windermere, though char exist in certain deep lakes in Scotland and Ireland. In my under-water tanks I have tried to photograph this fish; but the char is a delicate fish, and the illustration shown does not really represent it at its best. It is impossible to do justice to its brilliant hues except in a colour plate. In appearance it is absolutely brilliant; the back down to the lateral line—the line that can be seen on any fish, which is due to perforated holes through the scales along the middle of the body—is of dark green. This dark

The Char, a near relative of the trout, is a fish of brilliant hues, which it is impossible to do justice to in an ordinary photographic plate. Its beauty of coloration is an unforgettable memory to the student of fish life, or the lucky angler.

green gradually merges into a rich crimson which covers the under-part, and on the green sides are numerous dark red spots.

The char is a gregarious fish and swims in shoals. In the autumn, when they come to the shallows from the deep waters in which they usually dwell in order to spawn, they are netted in great quantities, and appear on the table as "potted char."

The rainbow trout is a native of the Pacific coast of America, and is a fish with which most people are familiar. One might imagine that its prominent black spots and marks over the back and sides down to the lateral line, would render it conspicuous on all occasions. On the contrary, the rainbow and Loch Leven trout, which I have watched swimming in my pond with roach and dace, are less conspicuous than their companions, except when seen against a perfectly uniformly shaded background. Such camouflage, of course, is seldom, if ever, met with under natural conditions in the sea.

Unlike the salmon and the sea trout at home, the rainbow trout spawns not in the autumn, but in the spring. A few rainbows which I had under observation spawned in May. Trout are supposed not to feed when they are spawning, but these rainbows when resting during their spawning operations were always ready to feed. On one occasion I threw no fewer than fifty meal-worms, one after another, to the trout, and not one of the worms was allowed to reach the bottom. Indeed, the relish with which these titbits was met was as keen at the last throw-in as at the first.

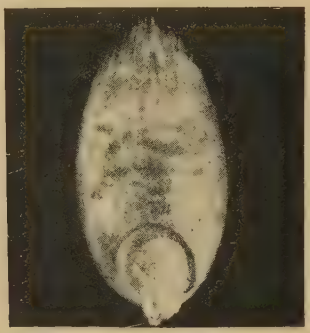
Other members of the salmon family are the brook trout of America, and the graylings, which are well-known in British and Canadian waters. Both are fine sporting fish; the former is a char, and in America holds a position similar to that of the brown trout in Britain. Attempts to introduce the brook trout into England have met with a certain amount of success in a few deep ponds and lakes.

Last, but not least, there is the very engaging group of the "white fishes" of North America. These differ from other salmonoids in having large scales and delicately shaped mouths. The Irish pollan is the best-known representative of this group in home waters. It should be kept in mind that in America the term "white fishes" applies to these large-scaled salmonoids, in Britain it refers to the roach, rudd, dace and other members of the silvery section of the carp family.

Britain is looked upon as the home of the brown trout, and in all parts of the world waters have been stocked with British trout ova. In transit, incubation is checked by cold; on arrival the temperature is very gradually raised, and then the ova are hurried up country.

A grain of wheat, highly magnified, showing tuft of hairs which collect moisture.

Shows the cleft which forms a sort of irrigation canal leading from the tuft of hairs to the germinating point.



Showing the "hump," beneath which lies the embryo wheat plant.

# 4.—HOW A GRAIN OF WHEAT GROWS

By HAROLD BASTIN

With photographs by the Author

HOW does a grain of wheat grow? In the last resort, this question remains unanswerable. Hidden invisibly in the germ there is a "something" that we call "life," which under favourable conditions gives evidence of its presence in the phenomena that we term "growth" and "development." But nobody has an idea, even vague and remote, of what this "life" really is. Yet a grain

On the second day of germination the skin above the embryo is ruptured.

On the third day the primary root appears wrapped in its sheath.

By the fifth day the sheath is split and the primary shoot and root are exposed.

On the sixth day the first pair of "adventitious" roots appear.

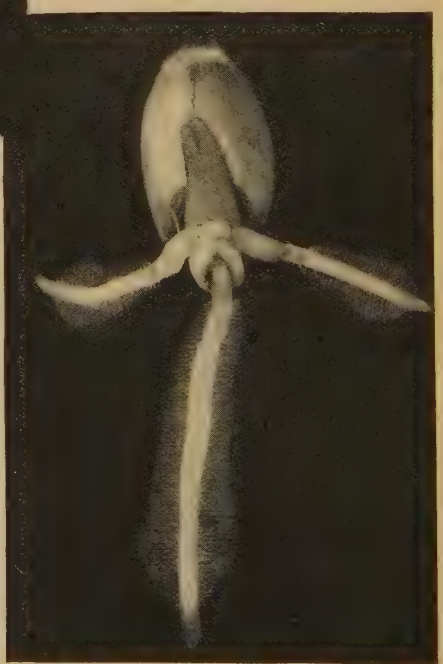
kind of vital legacy, through generation after generation, from its remote ancestral past. It is with the immediate "how" of this "race memory" that the following paragraphs deal.

If we examine a grain of wheat, separated from an ordinary farmer's sample, we see that it is spindle-shaped, with a cleft or channel on one side, and a tuft of silvery hairs at one extremity. Exposed to the influence of moisture, the grain swells, until all the wrinkles in its skin are smoothed away. Looking now at what we may call the "obverse" side of the grain, we notice again the tuft of hairs at one extremity, and at the other a sort of boss, or hump, bounded by a depressed area, or ditch. This hump will shortly call for our undivided attention. Beneath it lies the embryo, whence will issue the living wheat plant. For the moment, however, it will suffice to note that one extremity of the hump—that nearest to the hairy end of the grain—is termed (because of what lies beneath it) the "plumule," or young shoot; while the other extremity, for a like reason, is known as the "radicle," or young root.

This shows the root-tip further magnified. It is hairy, semi-liquid at the tip, and highly sensitive.

Turning the grain over and examining its reverse side, we still notice the tuft of hairs; we see, too, that the cleft or channel originates among these hairs. It is, in fact, a kind of irrigation canal, which conveys the moisture collected by the hairs to the germinating point, the radicle of which is seen protruding from beneath. In this way the young root and the young shoot are kept constantly moistened throughout the whole period of their early development.

It is important to realize that the major portion of a grain of wheat consists of a store of nourishment destined to support the young plant during its first struggle for existence, and until it is sufficiently established to obtain food for itself from the surrounding elements. This store is called the "albumen," and is quite distinct from the "embryo," with its plumule and



By the seventh day the three roots are burrowing into the soil, and the "plumule," or young shoot, begins to grow.

radicle. The albumen, in fact, resembles in its purpose the yolk-bag which is attached to and nourishes the young chick prior to its escape from the egg-shell.

The conditions necessary if a wheat grain is to germinate are moisture, warmth, and the presence of oxygen. Oxygen is in the air which fills the crevices between the particles of soil which surround the grain; moisture is absorbed both from the air and from the soil. Sach's experiments show that wheat begins to germinate below 5° Centigrade—say at about 40° Fahrenheit. But while germination may commence at this point, its progress will be slow, unless the temperature rises considerably. It is in the warm days of early spring that the young wheat plant thrives best.

The detailed particulars which follow relate to an experiment which occupied some 468 consecutive hours, with a temperature which varied between 38° and 60° Fahrenheit. This period covered the whole early history of the developing grain—from the time when it was first placed upon wet sand, to the time when the first folial leaf was fully expanded.

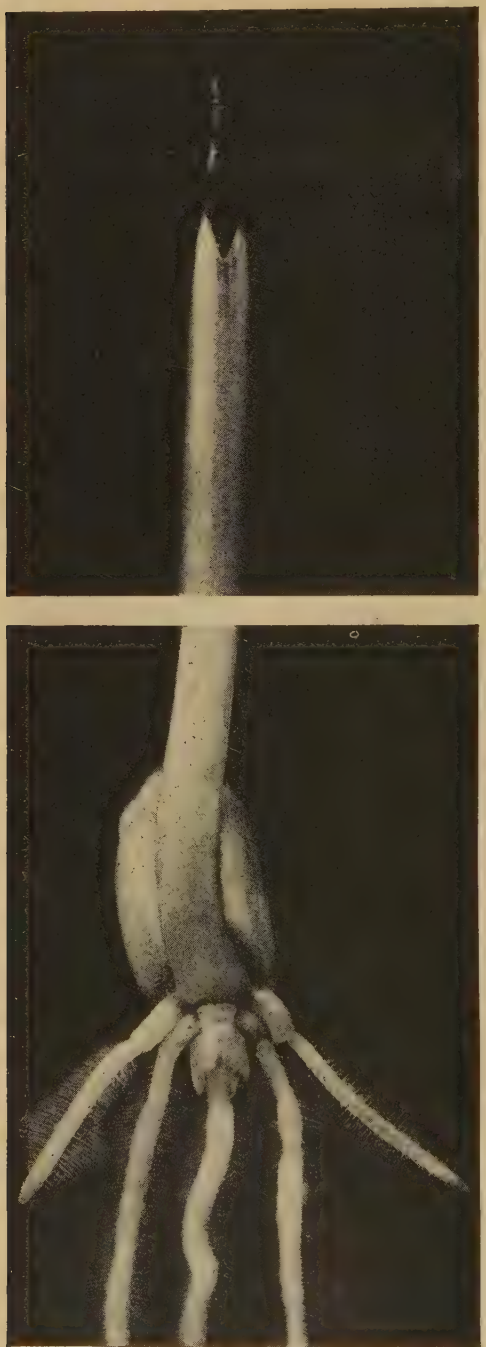
At noon on the second day—twenty-four hours after contact with moisture—the skin above the embryo was seen to have ruptured, leaving a slit reaching from end to end of the hump. Noon of the third day saw a white point protruding—really the primary root wrapped in its sheath. On the fifth day, at noon, the whole of this sheath was exposed to view, the outer skin was forced aside, while the tips of the young root and the young shoot were emerging from opposite ends of the sheath.

At this point it is often noticeable that the plumule is somewhat more advanced than the radicle. The gain, however, is short lived; for the next important stage, reached about noon of the sixth day, leaves the young shoot much as it was, while the young root has extended in a surprisingly rapid manner. Moreover, we notice that the tips of two other roots have made their appearance—the first pair of "adventitious" roots, as they are called; and we begin to realize, perhaps for the first time, that the development of a young wheat plant is a complex business, and that we have by no means seen the end of it.

Now let us pay special attention to the primary root. The fact of its rapid growth, seems to indicate its importance. Its special duty is to supply the increasing demand for moisture that the germinating embryo is making. It must procure, moreover, certain chemicals in solution which are required for building up the living

By noon on the twelfth day the plumule is growing well, and a second pair of adventitious roots appear.

cell-tissue of the plant which is to be. So the primary root burrows down into the soil, and develops root-hairs—delicate white filaments which spread out at right angles to the root itself. These hairs assist in the search for moisture; also, by their ramification among the minute particles of soil, they must add materially to the holding powers of the root—an important function in view of wind, or heavy rain, which may at any moment strain the anchorage of the tiny plant.

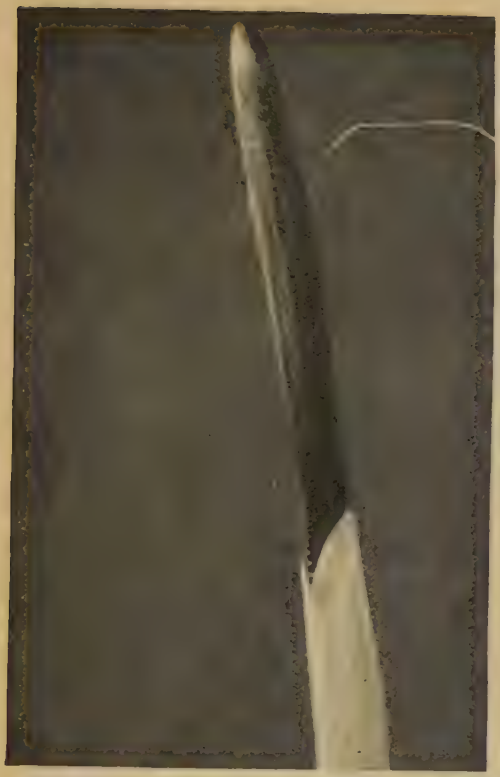


On the fifteenth day the first green leaf breaks through its sheath.

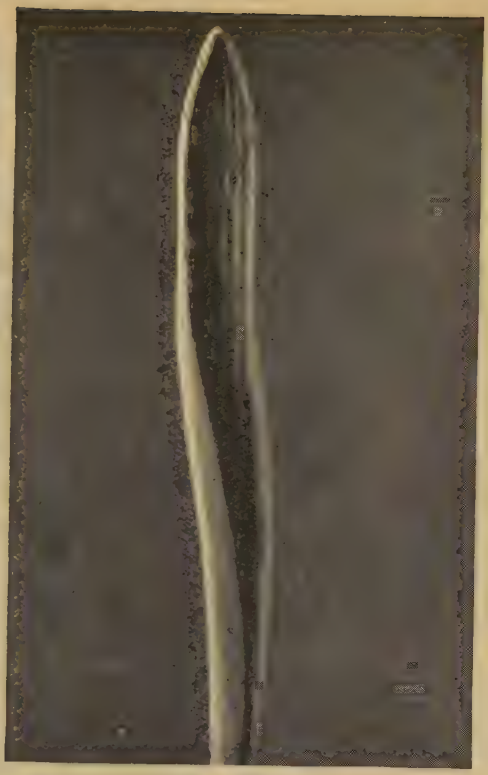
The most interesting part of the root, however, is its tip. This is semi-liquid and transparent; yet it exhibits an exquisite sensitiveness which enables it to avoid destruction, or threatened injury—feeling its way between the particles of soil, or round impenetrable obstacles. One is tempted to endow it in imagination with a kind of intelligence! Indeed, Charles Darwin likened a radicle to a burrowing animal, such as a mole, when he described its circumvolutions in search of suitable soil, and its return, after each interruption, to a downward course. Furthermore, the root-tip is gifted with a remarkable power of selection. It takes up from the moisture in the soil such chemicals as it needs, and leaves others for which it has no use! If, for example, we plant a pea and a grain of wheat in the same pot of soil, the root-tip of the former will search for and absorb the calcareous matter that the water of the soil holds in solution. But the root-tip of the wheat rejects this, and appropriates all the silex, or flinty matter, that it can get. Because of the building of this silex into the living stem of the wheat plant the straw is rendered sufficiently strong to support the ear and to withstand wind-pressure. It is said that there is enough silex in a well-grown wheat straw to make a bead of glass, when melted with potash with the aid of a blow-pipe! The pea, on the contrary, being one of those plants which clamber over and support themselves upon other vegetation, does not need silex to strengthen its stems, and so does not take it from the moisture in the soil.

Thus the primary root-tip of the baby wheat plant works its way among the particles of soil, generally with a downward tendency, but turning aside from obstacles in its path, or moving hither and thither in search of moisture and such chemical substances as it may need. Moreover, the primary root is not left to labour alone. We have already seen the formation of two adventitious root-sheaths; and from these issue, and pass down into the soil, the first pair of adventitious roots, which soon produce root-hairs, and exhibit all the characters which we have already noted in the primary root. This was the condition of the young plant at noon on the seventh day, the temperature then being 50° F.

It will be observed that the plumule has



On the sixteenth day the leaf had almost freed itself from the sheath.



By noon on the twentieth day the young wheat plant was an accomplished fact.

made comparatively little growth so far. But as the three root-tips continue to work their way into the soil, the young plant begins to feel its power—if we may so express it—and the pale yellow plumule makes more rapid growth. Strictly speaking, it is not a leaf, although it does some of the work of a leaf; its chief office is to protect the delicate first green leaf. Even now this leaf lies within, complete in every detail; but the status of the plant is not yet sufficiently assured to warrant its production. So the plumule moves slowly upward, and the roots continue to burrow more deeply into the soil.

At noon on the twelfth day there is another change to note. The tiny plant is about to send out a second pair of adventitious roots. The sheaths make their appearance, the root-tips emerge and commence their journey downward into the soil. Thus, by noon on the fifteenth day, our baby plant has a system of five vigorous roots, each endowed with individual powers of selection, but all labouring for the benefit of the one organism.

It is at this stage that the first green leaf breaks through its protecting sheath. Hour by hour it reaches upward towards the light; hour by hour the faithful roots burrow, like moles, into the dark, moist soil. At noon on the sixteenth day the leaf had almost freed itself from the sheath, but it was not wholly expanded. Then—as if the baby plant still mistrusted its powers to make good its bold adventure—a sixth root-sheath was hastily formed at the base of the plumule, and a sixth adventitious root passed downward into the soil to augment the labours of its five older brethren. Meantime the development of the leaf was slowed down. But by noon on the twentieth day the young wheat plant was an accomplished fact, with a root system of six units and a perfectly expanded folial leaf.

Two matured and well-developed ears of wheat. Owing to the fortuitous circumstances of the wheat plant's growth, difficulty to obtain symmetrical photographs was experienced, yet in the results it was found that the principle of growth, as described, had not been departed from in the smallest detail.

These notes, and the photographs which illustrate them, convey an impression of symmetrical growth which must now be dispelled. From the first, and although it is manifestly dominated in no small degree by the "race memory" to which reference has already been made, the tiny wheat plant shows infinite powers of adapting itself to circumstances. Thrown upon the bare furrow and washed into the soil by rain, it is surrounded by innumerable particles varying in size from sand grains to large stones. Among and around these the root-tips and plumule must find their way, the former downward, the latter upward, no matter how tortuous the course may be. Moreover, it is unlikely that the grain will fall exactly in the position necessary for straightforward growth. So that the baby wheat plant of a few days old has generally twisted itself into a confused tangle below the surface of the soil. A careful examination, however, will show that it has not departed in the smallest detail from the principle of growth which has just been described. Yet so sensitive are the root-tips, and so ready are they to turn from any obstacle, that—even under ideal conditions—considerable difficulty was experienced in obtaining plants sufficiently symmetrical in growth to make good photographs.

# How the Reptiles Live

*Photo: M. H. Crawford.*

The Glass-snake (*Ophiosaurus*), or Legless Lizard, has retained a pair of slender stumps to represent each pair of limbs. In the illustration the skin-flaps of both fore- and hind-legs are seen.

## 3.—A BRITISH LEGLESS LIZARD: THE SLOWWORM OR "BLINDWORM"

By P. CHALMERS MITCHELL, C.B.E., D.Sc., LL.D., F.R.S.

WHY should animals once blessed with four legs give them up? That is certainly what has happened in the case of the slowworm, the only British legless lizard. The course of evolution often seems to have been progress backwards, the degeneration and then the partial and even complete loss of an organ once useful, but become either unnecessary or an actual encumbrance. The ancestors of man and the higher apes certainly used to have tails, but man, like the gorilla and the chimpanzee, the orang-utan and the gibbon, have all lost them. In a great many of the other groups of baboons and monkeys there are some species which have the tail reduced to a stump or not visible at all. If they take to living on the ground more than in trees, the tail loses its chief use.

I do not know if lizards suffer from ingrowing toe-nails, or cold feet, but certainly a good many different kinds, especially those which take to living in holes, or in thick undergrowth or on the ground, have found that a snake-like body without limbs is more convenient for their purposes than the original type of structure—front and hind limbs with clawed hands and feet. The

process of degeneration is found in various stages. The so-called glass-snake, for example, has still got a pair of slender stumps to represent each pair of limbs, well shown in the photograph. It is a native of Europe, though not of Great Britain, but serves as a good introduction to our own slowworm,

*Photo: John J. Ward, F.L.S.*

The British Slowworm (*Anguis fragilis*) bears several external and internal characters which prove it to be a legless lizard. Its Latin name is derived from a peculiar fragility in the tail. The tip of the tail is partly buried in the ground.

a lizard in which there is no external sign of limbs although dissection shows a remnant of the pelvis. There is no doubt about the glass-snake and the British slowworm being lizards. That is shown by several external characters as well as by all the details of their internal anatomy. Unlike snakes, they have movable eyelids, the tongue notched instead of being deeply forked, and the scales on the belly in several rows instead of a single row of broad scutes.

The slowworm owes the second part of its Latin name (*Anguis fragilis*) to an extreme development of a fragility of the tail that, so far as I know, happens in no snake. If you pick up a slowworm, say by the back of the neck, holding it between the finger and thumb, it will struggle to escape, writhing vigorously and lashing about the hind end of its body until presently the tail actually breaks off; the muscles and skin at the wounded end contract, very little bleeding takes place, and the creature, especially if in your surprise you let it drop, almost certainly recovers. So far as I know it does not grow a new tail, and very many slowworms that are caught have clearly lost their tails. The photograph on this page shows one in which the tail seems to be perfect, although the tip is partly buried in the ground. But the illustration on p. 571 shows one which clearly has some time before lost its tail.

It has been suggested that the tail-dropping habit is an advantage, that if an enemy proposes to eat you, it is better to leave him with your tail than to be swallowed whole. But at least, in Great Britain, the slowworm has few enemies. Possibly the hedgehog which is fond of snakes, does not distinguish between the legless lizard and its usual prey the dangerous adder. I do not know, but from the business-like way it deals with an adder, I am certain that it would not be at all likely to be put off with the tip of a slowworm's tail. Adders themselves are great feeders on slowworms, chasing them, and, so far as I have seen, catching hold of them at any point of the body; possibly sometimes in an eager stern chase they have to remain content with a bit of the tail. Man is

*Photo: Edward Step, F.L.S*

In the above illustration the Slowworm is clearly seen to be minus his tail, which has probably gone some considerable time before. It is very doubtful if the slowworm grows a new tail: in any case, he gets on quite well without it.

another of the enemies of the slowworm, but he generally tries to kill it with a stick or spade, or with his heavy boot, taking it for a venomous serpent, and so is very unlikely to pick it up, the mode of treatment in which the poor th'ng is most likely to escape with a partial loss.

The slowworm is a gentle and very beautiful creature. Its habit of remaining motionless when suddenly alarmed or disturbed gives it its common name, and also allows it to escape notice in a great many cases. I have myself sat for many minutes within a few feet of a bank I knew to be a haunt of slowworms before seeing a fine specimen lying quietly, only partly covered by the herbage, just in front of my nose. Even the amateur naturalist should be as patient as the fisherman, content to lie quietly for an hour at a time, simply watching. Presently, when the disturbance caused by his arrival has faded, he will see creatures which in immobility blended with the background, betraying themselves by their movements. The shiny surface of the slowworm, like polished metal, sometimes silvery grey, sometimes almost as dark as gun-metal, but studded with small scales, blends extremely well with the shining surfaces of leaves, especially when only portions are uncovered. The young are even more beautiful, silvery white above, black below, with a thin black stripe along the back and on each side. Traces of these stripes are often preserved until the animals are nearly full grown. The young are born alive, that is to say, the thin egg-shell bursts either shortly before or just after birth, and the little creatures about an inch long, as thick as a common wooden match, are able to wriggle about at once, and take food in the shape

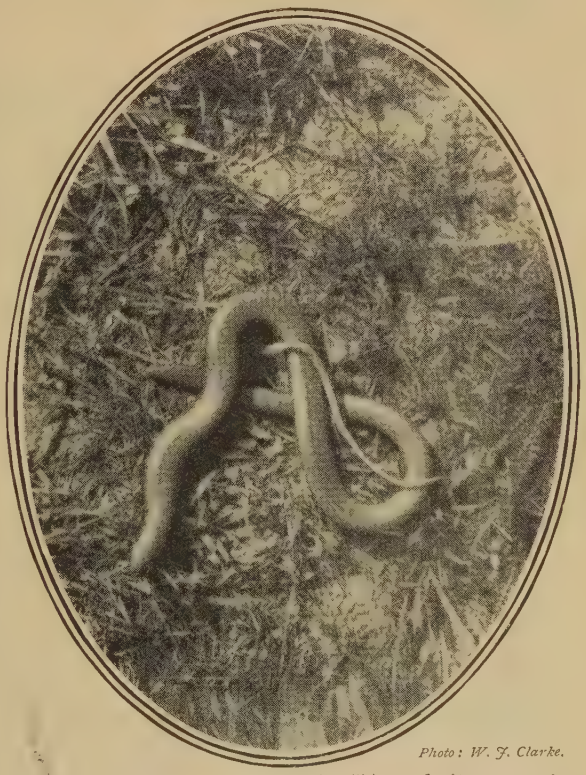


*Photo: W. J. Clarke.*

Adult Slowworm (*Anguis fragilis*) and its young, which is born alive, about an inch long and as thick as a match. It is able to provide for itself from birth.

of tiny spiders, insects and so forth. They are born in August or September, and there may be as many as a dozen in a litter. Their brilliant coloration to which a red iris adds an additional touch, is rather an exception to a general rule amongst animals, that when the young and adult differ in colour and pattern, the young are more inconspicuously coloured than the adults. This departure from the usual order is also found in many true snakes. But the exception to the rule may not in reality be a departure from the concealing habits of Nature. "Inconspicuous" is a word that can be rightly applied only with regard to the circumstances. The banks on which the young slowworms come out to sun themselves have many little dazzling points of colour, deep black lines of shadow, and silvery sheens on moist leaves. What seems brilliant and conspicuous in the museum or on the hand, may really fit so well into the normal surroundings as to serve the purpose of concealment far better than a shape-betraying, even shade of grey or brown.

Slowworms are absent in Ireland, where one would have expected that the relatively mild and moist climate would have suited them. They are to be found in almost every county in England, Scotland and Wales, but they prefer the warmer and damper west. They come out from the winter hibernation rather earlier than other British reptiles, and seem to be little susceptible to cold. I have seen them in Dorset in February, but my earliest record for Scotland is the end of an unusually warm March in a sheltered garden on the west coast. Adults are from twelve to fifteen inches long, but even larger examples have been caught. They move with remarkable speed, notwithstanding their popular name, and with apparent absence of effort. Their food is varied, small spiders, insects and earthworms being taken. But their favourite food consists of slugs, and so every gardener should encourage them.

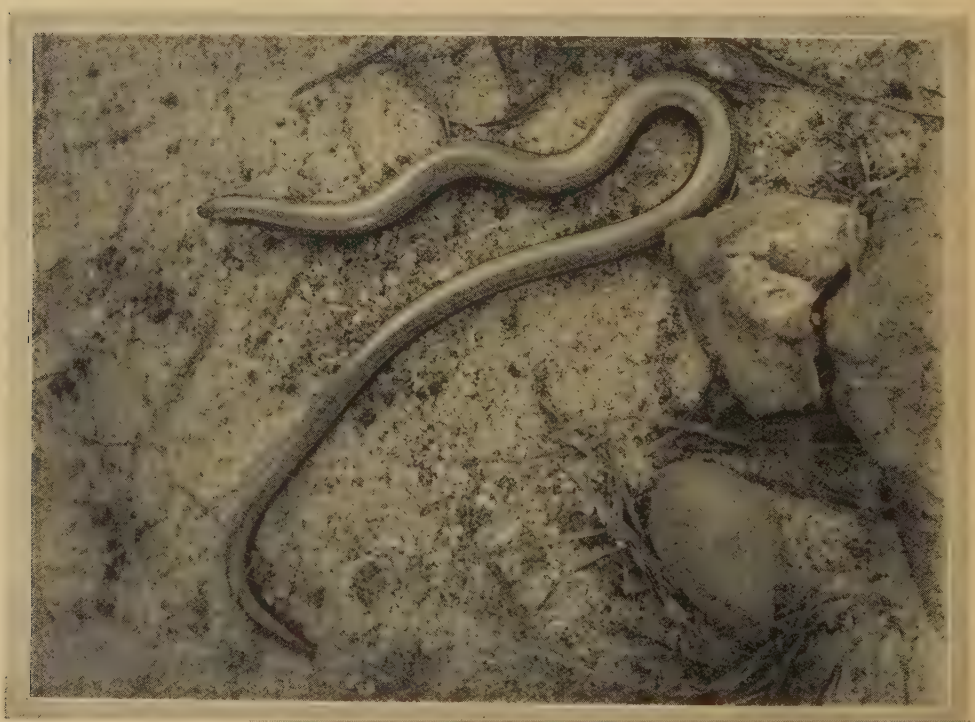


*Photo: John J. Ward, F.E.S.*

The Slowworm (*Anguis fragilis*) hunting for slugs, which form a chief part of its diet. Notwithstanding its popular name, it moves with considerable speed and without apparent effort.

*Photo: A. W. Dennis.*

All the hundreds of different varieties of garden roses have been developed from this simple little five-petalled Dog Rose.

# VII.—Children of Summer

*"WHEN roses come out then Summer comes in!"*

Those had been Spring's last words as she slipped away on the ray of June sunshine.

And roses now were out in all their glory. In the garden—red, yellow, orange, pink and white—the cultivated flowers blossomed and shone, while over the hedges everywhere, simpler and sweeter, pale wild roses were flinging their sprays, making starry archways into Fairyland.

Boldly into Fairyland walked the children; under the roseways passing, there they came upon Summer—all among the flowers they saw her sitting, the great Fairy Summer!

She was not young, nor sparkling with laughter and dance, like their dearly loved Fairy Spring; but she was stately and beautiful. And she had eyes that were deep and loving and yet as full of storm as of tenderness.

Boodles hung back a little, Popsi hesitated too, wondering, but Topsy ran to her and took her hand.

"I wondered when you would find me, children!" she said in her deep rich voice. "I have so many treasures that I want to show you!"

"Oh, please!" cried Popsi, "we want to see just everything that there is in the world!"

Summer laughed. "That may take you a long way!" she said. "Suppose you begin just where we are sitting. I believe that in

this little corner of river bank you would find enough to last you the rest of your lives!"

"Oh!" cried Popsi disappointed. "Why, there's nothing there but the meadow-sweet!"

*Photo: Albert H. Willford.*

On the Meadow-sweet a White Butterfly was sitting.

"But see how lovely it is!" said Summer, "with its rich red stems and sweet-scented creamy flowers! In Fairyland we call it the Queen of the Meadows. It belongs to the rose family too—and the rose is the queen of all the flowers! But let us see what else we can find!"

"There are lots more flowers, if you look!" said Topsy. "There's a little starry stitchwort, and some Queen's lace."

"And a thistle, and a blue speedwell, and a flowering rush!"

"And an iris——" The children were peeping and peering, seeing who could discover the most in that one little corner of the bank.

"I see a white butterfly sitting on the meadow-sweet!" said Boodles solemnly.

"So there is!" cried Topsy. "That's the kind that lays the eggs that hatch into caterpillars that eat the cabbages! Daddy said we were always to kill as many as we could!"

"No! No!" said Summer, "I can't have you giving my creatures a bad name like that. Look at the dark veins on the under-wing. It is a cousin of the cabbage white butterfly; but this kind is much more fond of wild flowers than of your Daddy's cabbages."

"That's a good thing," said Popsi, for she could not bear to see things killed—not even wasps when they buzzed round the jam at tea-time.

"And look!" cried Boodles again. "There's a war-horse, all in shining armour, prancing up that reed!"

"Oh!" cried Popsi, "isn't he lovely! Look at his great wise-looking head!" She put out her finger to touch him, but—in a twinkling the grasshopper was gone, up in the air and out of sight.

"Oh! I would *love* to jump like that!" cried Popsi. "How *did* he do it?"

"I suppose if you went on wishing for about a million years——" said Summer, "you might grow long, doubled-up legs like his. There's no telling what wishing

*Photo: Henry*

How many different plants can *you* find in this one patch of the river bank?

will do, if you only wish hard enough!"

"It *would* be fun!" said Popsi, longingly. "I'd jump right over the house!"

"Now—I will tell you a funny story about grasshoppers!" said Summer. "Millions of years ago, that little creature's ancestors took a lot of trouble to grow wings, and they used to fly about with them like beetles do. Then suddenly some of them started hopping. And they found that hopping was such fun and such a good way of avoiding their enemies that they hopped and hopped more and more, and the more they hopped the more lazy they got about flying. So the wings grew weaker, and the legs grew longer and stronger. Then a still stranger thing happened: they took to using their wings not to fly with, but to chirp with!"

"To chirp with?" cried Topsy. "How?"

"By rubbing them across each other," explained Summer. "The noise it made pleased them so much that it became quite a habit. And at last the wings of the crickets developed a rough ridge like a file that makes a loud rasping noise when they are rubbed together."

"I know!" cried Topsy. "I've heard it in the grass, on very hot days!"

"Yes—crickets and grasshoppers are Summer's own children. They are never so happy as when it is hot and dry!"

"Oh! isn't it lovely that Summer's here!" cried Topsy. "You *won't* go away again yet, will you?"

"As long as the roses stay I shall stay!" answered Summer, "and wherever the sun shines and the little flies are dancing—there you may find me!"

*Photo: Stanley Crook.*

The Grasshopper has long, doubled-up legs, with such strong muscles that when they are suddenly straightened they send the little creature away into the air, jumping a hundred times as high as itself.